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# CONTENTS

## SYMPOSIUM ON MINOR SURGERY

### PAGE

<b>Foreword Minor Surgery and Its Responsibilities</b> <i>By Dr Warren H Cole</i>	1
<b>The Treatment of Open Wounds of the Hand</b> <i>By Dr Michael L Mason</i>	4
<b>Infections of the Hand</b> <i>By Dr William H Requarth</i>	27
<b>Minor Surgery of the Eye</b> <i>By Dr Louis Bothman</i>	46
<b>Minor Surgery of the Neck</b> <i>By Dr L W Peterson</i>	56
<b>Superficial Tumors of the Head and Neck Area</b> <i>By Dr Danely P Slaughter</i>	69
<b>Minor Surgery of Nose and Throat</b> <i>By Drs Francis L Lederer and M H Cutler</i>	82
<b>Benign Lesions of the Breast</b> <i>By Dr Harry A Oberhelman</i>	95
<b>Skin Grafts</b> <i>By Dr Paul W Greeley</i>	113
<b>Local Treatment of the Whole Thickness Burn Surface</b> <i>By Dr Harvey S Allen</i>	125
<b>Varicose Veins and Ulcers</b> <i>By Dr Frank V Theis</i>	134
<b>Peripheral Arterial Obstruction</b> <i>By Dr Ormand C Juhan</i>	154
<b>Foreign Bodies</b> <i>By Drs Egbert Fell and Fay H Squire</i>	174
<b>Sprains and Minor Fractures</b> <i>By Dr Carlo Scuderi</i>	185
<b>Minor Surgery of the Foot</b> <i>By Dr James K Stack</i>	196

	PAGE
Minor Urologic Surgery	206
By Dr Joseph H Kiefer	
Minor Gynecologic Surgery	222
By Drs Herbert E Schmitz and George Baba	
Hazards of Anesthesia for Minor Surgery	228
By Drs W H Cassels and L L Teplinsky	
Plaster of Paris Technic for the Application of Casts	241
By Dr Claude N Lambert	

ADDITIONAL ARTICLE

Clinicopathologic Conferences I Diverticulitis of the Colon, Old Rheumatic Heart Disease and Hepatitis II Saccular Aneurysm of the Left Branch of the Hepatic Artery	262
By Drs Italo F Volini and Hans Popper	

# THE SURGICAL CLINICS of NORTH AMERICA

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CHICAGO NUMBER

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## SYMPOSIUM ON MINOR SURGERY

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### FOREWORD

#### MINOR SURGERY AND ITS RESPONSIBILITIES

THERE is considerable controversy as to whether the term "minor surgery" should be retained, since it is well known that serious complications may follow even the simplest type of surgical operations. I personally favor retention of the term, if for no other reason than to indicate that certain types of operations are more difficult than others, furthermore, its abolition would exert little influence on the fact that many physicians and surgeons often perform operations beyond the limits of their skill and knowledge. It is granted that to the inadequately trained surgeon operations of slight magnitude commonly designated as 'minor surgery,' are in reality major surgery to that individual and vice versa. The important feature which should be appreciated by all surgeons is that they must *carefully assay their ability*, making sure that they are not only able to perform the operation, but of more importance, are able to *take care of the complications which may develop during that operation or during the postoperative course*.

The purpose of this volume is to describe the manifestations of the less complicated lesions and describe the preoperative and postoperative care as well as the technic of the operations designated as minor surgery. Various organs in the body are included in the discussion although the treatment of lesions in organs such as the brain, lung and liver, which are enclosed in the various major cavities of the body, is considered too complicated to be classified as minor surgery. Exclusion of these organs is based largely upon the fact that they are relatively inaccessible and are vital to life. Likewise the treatment of malignant disease, except for basal cell carcinoma and slow growing tumors of the skin or mucous membrane, must be considered major surgery, largely because radical and complicated operations are usually required for adequate treatment.



It is also our purpose to call attention to the more important complications which may develop in minor surgery and to present methods for their prevention.

*Infection* occurs with surprising frequency in minor surgery owing

technic. Although all surgeons would agree that wearing a mask is essential in abdominal or chest surgery many would not hesitate to remove a cyst or small tumor of the skin without wearing one. This erroneous attitude is presumably explained on the assumption that if infection does develop following minor surgical procedures it cannot be serious enough to jeopardize life and it is therefore not essential to take the usual precautions even though it is well known that the peritoneal cavity is much more resistant to bacteria than is subcutaneous tissue. Such a careless attitude is obviously inexcusable par-

emphasized as common causes of infection.

*Hemorrhage* is a complication that frequently converts a relatively minor operation into a major one. At times it results from insufficient knowledge of anatomy on other occasions from inadequate knowledge of technic.

*Inadequate knowledge of anatomy* is a frequent cause of the poor performance or failure of an operation. This deficiency is naturally

most common in the untrained surgeon but it is also

perat

eon is

well trained in surgical anatomy, but it is also because of anomalies that are particularly common in certain parts of

*Inadequate examination of the patient* is a common cause of poor results even though the operation was performed correctly. Any of a number of complicating diseases including hypertension, nephritis and tuberculosis may give rise to disastrous results even when the operation was of slight magnitude and performed correctly. The fact that this error can cause such serious consequences makes it imperative that the physician examine every patient thoroughly even though

the operation is trivial. Improper examination  
e of poor results. For example  
midline of the anterior surface

of the neck or lack of appreciation of diagnostic possibilities may give rise to the serious error of operating on a thyroglossal duct cyst in the physician's office under the mistaken diagnosis of sebaceous cyst. Careful examination in the presence of such lesions usually will reveal a cordlike structure leading upward from the superficial nodule into the deep structures of the neck.

*Error in diagnosis* is a common and important cause of poor results in minor surgery. Although the error may be caused by careless and hasty examination as mentioned above, it is probably due more frequently to lack of experience in the physician. Errors in differentiating basal cell from squamous cell carcinoma and fibroadenoma from carcinoma of the breast are common examples of diagnostic errors which may lead to serious results in minor surgery or more accurately in surgery which was considered to be minor.

*Insufficient training in surgical technique*, as discussed in the first paragraph, is perhaps the most important cause of poor results in minor surgery. It may be responsible for innumerable complications including infection, hemorrhage, incomplete removal of the lesion, delayed healing and malfunction. Obviously the only answer to this problem is better training of the minor surgeon. It is not possible for

Likewise it is o

others. These features are beyond the control of the profession. However, it is a responsibility of the surgical profession to improve its standards and training, and a responsibility of the medical profession in general to support the principle that a surgeon must be sufficiently well trained not only to perform the operation in question but also to take care of complications which may arise at the operating table and in the patient's convalescence from such an operation.

WARREN H. COLE, M.D.

*Consulting Editor*

## THE TREATMENT OF OPEN WOUNDS OF THE HAND

MICHAEL L. MASON, MD, FACS\*

THE principles of management of open wounds of the hand are the same as those applying to open wounds anywhere. The functional loss which may follow such injuries has given them a special interest to the surgeon while their frequency in every walk of life particularly

geon is interested from the time of his internship onwards since injuries of the hand are the most frequent wounds he is called upon to treat.

The principles of management of open hand injuries may be tersely epitomized as follows:

1. Protect the open wound immediately from all further injury—mechanical, chemical, bacterial.

2. Determine the extent of the injury.

3. Transform the open contaminated wound into a clean wound at the earliest possible moment.

4. Excise devitalized tissue.

5. Repair deep structures immediately if conditions permit and if primary healing can be anticipated.

6. Close the wound by suture or skin graft as soon as it is safe to do so immediately in most cases.

7. Apply compression dressing and put the hand at rest on a splint until healing has occurred.

8. The goal of surgery is functional restoration.

It would serve our purpose to discuss these principles in connection with the presentation of cases recently cared for on the Service of

of the cases will require much further surgery before they can be con-

met

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## CASE I (P M H No 97045)

A 31 year old dairy employe stumbled and fell cutting the palm of his right hand on a clean milk bottle at about 2 P M. A tourniquet was immediately applied

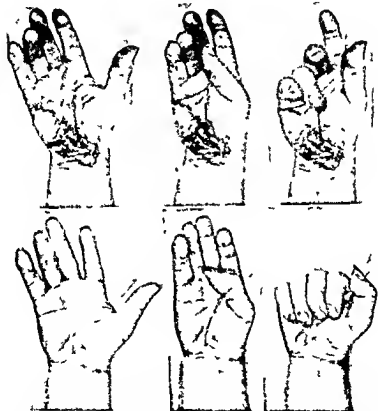


Fig 1 (Case I) —Laceration of wrist on milk bottle with division of median nerve flexor pollicis longus flexor digitorum sublimis and profundus of index and middle fingers Primary nerve and tendon repair two hours and a quarter after injury Lower row of figures show hand three months after repair

after injury) and was prepared for immediate surgery Examination of the hand in



cated This judgment is based on several factors Time since injury is an important consideration Ordinarily if the injury is over four hours old no type of tendon repair should be attempted Occasionally, in the very exceptional wound tendons over the dorsum of the hand i.e. over the metacarpus (*not in the carpal tunnel*) may be repaired if the four hour limit is slightly exceeded Never should this time limit be exceeded for any other tendons In case of the tendons in the digital sheaths we must never exceed a limit of two hours between injury and time of repair and here in most cases an hour should be taken as the limit There is nothing magical about time that in itself precludes tendon repair The reasoning back of such strict time limitations are much the same as those which contraindicate primary closure of wounds over eight hours old namely the danger that contaminants may have had time to gain a foothold in the tissues and cause trouble especially in poorly vascularized tendons In the case of tendon division it is practically always necessary to make accessory incisions through undamaged tissues and the surgeon must be reasonably certain that he is not carrying invasive organisms into normal tissues

Tendon is poorly vascularized and is very susceptible both to infection and to pressure resultant from inflammatory exudate Minor inflammatory reactions which may be of little or no importance in areolar tissue or muscle will often lead to marked disturbance in tendons and even if destruction does not occur will cause seriously crippling adhesions

There are other considerations as well as time upon which decision to perform primary tendon repair is made The surgeon must seek out possible sources of contamination How was the wound sustained? If by a clean or relatively clean agent he need not fear primary inoculation of virulent organisms If on the other hand the injury was due to human teeth the

Can invasive bacteria may have been introduced into the wound from any other source? What was the nature of the agent? Did the wound involve any structures? from which structures? the wound? Have proper skin flaps? agency for the repair tendons?

Can the wound be closed primarily after tendon repair? If primary closure cannot be accomplished then the tendon repair must wait and be done as a secondary procedure under proper skin flaps It may be

possible to close the wound by means of split grafts but these cannot be laid over tendons or over the site of tendon (or nerve) suture. In such cases a pedunculated flap will be needed and tendon repair performed under it at a later date.

The nature of the injury is important. Tendon repair is more likely to succeed in sharply cut incised or lacerated wounds than in crushing severely contused wounds. Certainly extensive tendon repair would be inadvisable in such wounds as punch press injuries. Where compound fractures are present at the site of tendon injury it is rarely advisable to perform a tendon suture.

The surgeon who has been satisfied with the technique of tendon re-

Lastly the surgeon should remember that secondary repair of divided nerves and tendons can be undertaken three to five weeks later in a wound that has healed by primary intention. If, however, disturbances in healing supervene or frank infection develops or

if advised primary nerve or tendon repair has been performed, the situation is much more complicated. The repair will be much more difficult and the extensive fibrosis resulting from the inflammatory

process will make it difficult to locate the ends. The surgeon must also control

over the original wound, but he does have control over the incisions he makes to enlarge it. It is seldom possible to locate both tendon ends in the wound. Occasionally the distal stumps are easily located by flexing or extending the wrist and fingers. More rarely will the proximal stumps come into view by any sort of maneuver. Certainly "fishing" for them with forceps is poor technique and not to be recommended. Even if the two ends can be brought into the field it is seldom possible to perform a satisfactory suture with the limited exposure usually afforded by the original wound. It is much less traumatizing to the tissues to make clean sharp well planned enlarging incisions and obtain exposure than to try to secure it by forceful retraction.

A few very specific guides or principles furnish the surgeon with a basis for making these accessory incisions. In all cases an at-

cross skin folds transversely They should avoid the midline of fingers, palm, wrist and forearm Over flexor and extensor surfaces, incisions should run transversely while the longitudinal prolongations of the incisions should run along the sides of the digits or forearm Where it is necessary to cross from the palm or dorsum into the forearm, transverse incision is made across the wrist to the radial or ulnar border of the forearm Wounds follow no such simple rules, but the surgeon can usually adapt his enlarging incisions to the wound by curved incisions from one or both ends of the wound and make them conform to the physiological principles noted above

One of the most common faults seen in enlarging wounds is the vicious criss cross incision, i.e. a longitudinal incision made in the midline of finger, wrist or forearm crossing the center of the original wound These incisions heal poorly because of the disturbed vascularity and difficult closure of the central area where four points come together Under such an incision the repaired nerves and tendons are covered over their entire course by the long scar of subcutaneous and skin closure The longitudinal scar invariably shortens and produces a flexion contracture of the wrist or finger In a great many instances the repair is functionless and secondary operation becomes necessary if the patient is to regain function This is exceedingly difficult because of the constricting scar which must often be corrected first, a procedure which may entail a pedicled flap

**Use of the Blood Pressure Cuff to Procure a Bloodless Field.**  
—This is another point in technic illustrated in the case just cited While the principle of the bloodless field has been pretty well accepted in surgery of the hand, there still seems to be some confusion regarding the method of obtaining it It must be obtained by means of a blood pressure cuff pumped up to about 280 mm of mercury but not higher This pressure may be maintained as long as necessary to com-

is again inflated to 280 mm of mercury, and is kept inflated until the operation is completed and the compression dressing applied We have never experienced any trouble from this procedure even though the cuff may have been inflated for one and one half to two hours before the preliminary release to catch bleeders, and for a further two and one half to three hours after ligation of bleeders before it is finally released Higher pressures than those recommended above are produced by the ordinary tourniquet and also by some types of pneumatic constriction apparatus In cases where high pressures are produced and maintained for long periods of time, there is no doubt but that constrictor paralysis may be produced We have never seen it occur when the ordinary blood pressure cuff is used as we have outlined



## CASE II (PMH No 90846)

The 36 year old woman slipped and thru t h s left hand into a ceiling  
 hatch at 8 15 A.M. He was taken immediately to a hospital where a sterile dressing  
 was applied and a grain of morphine given and was then sent to Puavant  
 Memorial Hospital where he arrived at 9 45 A.M. On June 7 1946 (one and one-half



nurse

at 2 m

on the

of the middle phalanx  
 retained a useful hand (Fig 2)

The features in this case, to be discussed, are the method of handling avulsed and crushed skin, the use of a splint following surgery of the hand, and the value of compression dressings.

**Method of Handling Avulsed and Crushed Skin.**—The viability of skin, or any tissue, depends upon competent vascular supply and/or upon the actual amount of structural damage the tissues have sustained. Either one or both of these factors the surgeon must attempt to assess. Either or both factors may be produced or furthered by surgery and after care. Disturbances of blood supply may be due to the injury itself dividing vessels to the area, to surgical division of small but important vessels, to venous congestion because of inadequate support of surface veins, to pressure of edema or hematoma shutting off arterial supply. Structural damage to the skin causing actual tissue death is frequent in crushing, jagged lacerating and abrading injuries. The surgeon himself may cause it by grasping of tissue in heavy forceps, and by attempting to gain exposure by forceful retraction rather than by accessory incisions.

**Value of the Compression Dressing.**—Venous congestion which permits stagnation of blood is largely a matter of after care. It is often determined by the initial dressing put on at operation. In this connection the reader is referred to the article by Dr Sumner L. Koch on the use of compression in surgery. Here we find stated most clearly and logically the surgical principle of compression as applied to wound surgery. The value of compression in the prevention of venous congestion is common knowledge to all of us in the treatment of varicose veins by means of the Unna's paste boot. Its value in skin grafting, both for free grafts and pedunculated flaps, has been repeatedly demonstrated. In the past war compression was an integral part of the management of wounds. Oftentimes a flap of skin partially detached from its base but still retaining a pedicle may survive if, after it has been carefully sutured into place, it is properly dressed with a large resilient pressure dressing which prevents the veins from becoming distended, and restores to them their natural physiological relationship. Pressure also tends to keep the flaps in place, which follow

**The Use of Splints** following injury is an important feature in the after-care of any wound, whether fractures are present or not. All tissues heal better if kept at rest; they are better able to combat infection, or to prevent the development of it if invasive contamination is present. In surgery of the hand there are certain specific indications for splinting and for the manner of splinting to be carried out in various types of cases. The indications for splinting are to put a part at rest during the healing following injury; during the acute stages of acute infections to immobilize divided tissues, including tendons and fractured bones.



## CASE III (PMH No 96115)

This patient was admitted to Passavant Memorial Hospital at 4 P.M. with a history of having cut his left hand on a circular saw about one and one half hours previously. Aseptic examination of the hand revealed a jagged  $2\frac{1}{2}$  inch laceration across the thenar eminence of the left hand (Fig 3) inability to flex the thumb and sensory loss over the whole volar surface of thumb. The patient was in good condition for surgery and was taken to the operating room and anesthetic started.

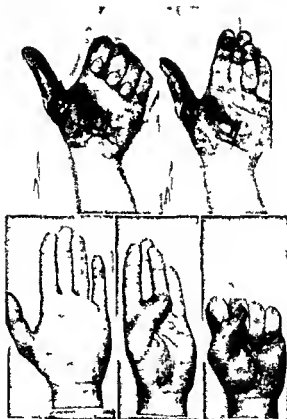


Fig 3 (Case III) —Circular saw injury to left hand with division of flexor pollicis longus both digital nerves to thumb and insertions of thenar muscles. Primary repair two and one half hours after injury. Condition on admission and one month after surgery.

at R. D.

J.

E.

After careful excision of devitalized tissue the nerves and the tendon were sutured end to end, the thenar muscles were repaired and the wound was closed.

The hand was splinted with the wrist in acute flexion and with the thumb moderately flexed to relax the sutured nerves and tendons. Healing occurred by primary intention.

**Interval between Time of Wounding and the Primary Care and the Indications for Primary Closure of the Wound**—Whether the surgeon would elect to do a primary closure would depend upon a number of factors. They all have to do with considerations as to whether or not he feels that he has been able to convert the open contaminated wound into a surgically clean wound and whether he can anticipate healing by primary intention. He makes this decision on several factors. One of these is time. Ordinarily a limit of six to eight hours from the time of injury is considered the interval within which a contaminated wound may be rendered surgically clean, the concept being that while no wound is ever bacteria free, six or eight hours are required for pathogenic contaminants to become invasive. It was hoped that local sulfonamides would increase this safe interval but clinical proof of this hope has never been furnished. The practice has been almost universally discontinued. In the early part of the past war the brilliant results ascribed to the local use of sulfonamides were later attributed by thoughtful surgeons to conditions surrounding the reception of the injuries. Time is probably not to be taken slavishly as absolute criterion for primary closure, but exceptions to the rule are rare and only under favorable circumstances would a surgeon consider primary closure of a wound over eight hours old.

The conditions under which the wound has been received are undoubtedly of significance. A wound received under relatively sterile conditions by objects not seriously contaminated and affecting rela-

knife used by an autopsy surgeon

The nature of the wound is to be taken into consideration also. A

instances has been lowered with infection and the re

a factor. It has been well known that wound infection is due to germs rather than at the time they come from the nose and throat of the patient or attendants. To look into the uncovered wound or hover over it. Fingers, unsterile instruments, questionably

sterile dressings and long exposure of the open wound are all possible sources of serious contamination. If the wound was covered at once with a sterile dressing and has not been exposed to "human contaminants" there is good possibility of its being reasonably free of invasive bacteria.

**The Value of Penicillin**—Penicillin was administered in this instance because of the nature of the injury with its associated tissue damage beyond the site of actual tissue division. Cuts from saws rank close to crushing wounds in producing wounds which damage tissues and render them less able to cope with healing, and contaminants. Saw cuts also tend to carry in organisms which lead to considerable wound disturbance. Whether this is due to carrying in  
 ' ' a intro  
 leashed  
 or not

penicillin has been of value in an individual case such as this has been difficult to say. It has seemed to me that our results in recent cases seen early and accorded satisfactory primary care and in which penicillin has been used are not strikingly better than in similar cases treated in the prepenicillin days. I do not mention the sulfonamide days since I did not use the sulfonamides in acute traumatic cases and except for its very occasional use in acute infections have scarcely used it at all. Penicillin on the other hand has been used quite freely, not in every case by any means but certainly in a large number of instances. It has to recommend it besides its bacteriostatic effect a reputation for being harmless or practically so, a statement that can not be made for sulfonamides. The effect of penicillin on acute spreading infections has been striking but penicillin will not prevent infection in poorly treated wounds.

It must be emphasized here that we are referring to cases seen within a very few hours after injury (two to four) in which it is evident that infection has not yet started and which by criteria established in prepenicillin days were suitable for primary nerve and tendon repair and primary closure. If the case is seen late and infection has already developed there is no doubt that penicillin will bring the process under control very quickly in most instances. I cannot feel however that penicillin will permit us to overstep the earlier established indications for primary closure and tendon repair. Nor will penicillin permit us to be less thorough in our cleansing and wound excision.

CASE IV (PMH No 96926)

shock was present, and at 3 20 P M (three and one-quarter hours after injury) he was in the operating room under anesthetic and the wound was being cleansed. The thumb was found to have been amputated through the proximal end of the proximal phalanx and was attached only by the almost completely avulsed flexor pollicis longus tendon (Fig 4) The skin had been torn away from the remainder of the thumb along a line on the volar surface at the level of the metacarpophalangeal joint

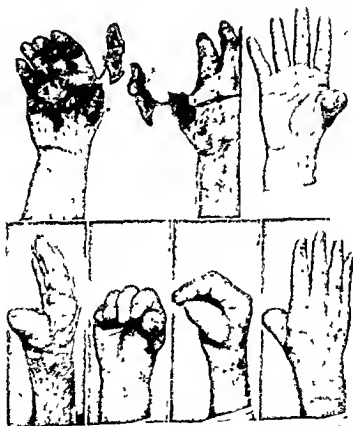


Fig 4 (Case IV)—Avulsion of right thumb in pulley belt. Primary application of pedunculated flap three and a quarter hours after injury. The hand on admission and three months later.

at 3 20 P M of the same day

pedunculated flap as follows. The raw surface left by excision of skin over the dorsum of the wrist was closed by suture, and the area left by excision from the dorsum of the hand was covered with a split graft. The denuded remnants of the thumb were placed under a pedunculated flap on the abdominal wall. Three weeks later the flap was further outlined to produce a tubular encasement for the thumb, one week later one border of the flap was swung around the thumb and two weeks later the pedicle was divided completely.

There are several points of interest in this case: (1) immediate application of a pedunculated flap, (2) the white avascular areas of skin and skin raised up from its underlying nutrient tissues.

**Immediate Application of a Pedunculated Flap.**—The immediate application of a pedunculated flap to obtain closure is occasionally indicated. Where it is needed, it is of inestimable value. The pedunculated flap is indicated when tendon and bone are exposed, when whole digits are denuded, and in such conditions as the degloved hand. To leave areas of this sort uncovered leads to inevitable necrosis of exposed bone and tendons and months of waiting before cover

débrided, a flap can be applied as a secondary procedure four or five days after injury. Too often, however, the case received four or five days after wounding is not found to be sufficiently clean to allow the application of a flap.

**Skin Which Has Been Subjected to Severe Crushing and Tearing.**—The second feature of interest and importance is the decision regarding skin which has been subjected to severe crushing and tearing. The surgeon is forewarned if he knows how the injury has been received because he may then be more wary in taking any chances with questionable areas of skin. Skin which has been simply incised or sharply lacerated is devitalized along its edges only and requires little or no excision. If we add a very moderate avulsing effect such as may occur if the lacerating agent is very irregular and tears the skin pulling it away from its base for short distances, it may still not be too greatly damaged and may require only minimal excision and proper after care. Brush burns and crushing injuries, however, produce quite a different effect on the skin. There may be actual heat effect from the abrasion. The skin may be actually crushed to death from a very great weight falling on it or passing over it. There may be added to this, tearing of the skin from its underlying tissues, which themselves are crushed and devitalized. The skin may be separated into its dermal and epidermal layers.

With a history of severe crushing and abrading the surgeon must look very critically at all wounded skin, must examine it carefully and be liberal rather than miserly in his excision. White avascular skin, in case of an injury with history of severe crushing, is sure to



become necrotic and must be removed. The surgeon must carefully scrutinize crushed areas which may look satisfactory in order to be

under which is the necrotic derma. The appearance of the skin gives some indication of its vitality. Crushed discolored skin which does not bleed and which is separated from its subcutaneous tissues is usually nonviable. Similarly white avascular areas resembling third degree burns are also nonviable and should be excised.

Occasionally the decision to excise skin can be more easily made at the time the blood pressure cuff is released while the surgeon observes the return circulation during the stage of reactive hyperemia. Avascular areas show up a dead white against the bright pink of well vascularized areas. When depending on this test the surgeon must wait a few minutes since the hyperemic blush does not come all at once but appears later in some areas than in others. To be looked for also are spots of dusky discoloration in which it is apparent that venous return is impeded since such areas may also become gangrenous. The surgeon must be sure that flaps of skin are not turned back

split graft can be placed. If this simple method is used, cable, the end result is likely to be more satisfactory than if a pedicle has to be raised, the reason being that immediate transfer of pedicle flaps is not so safe or so certain as delayed transfer.

CASE V (PMJ No 97814)

June 12 1947

the hand elevated a voluminous pressure dressing and splint were applied and penicillin was started 40 000 O/U every three hours. Both swelling and pain subsided as soon as the hand was splinted. The temperature remained satisfactory touching 99° F on one occasion only.

On June 16 six days after injury the patient was taken to the operating room and

held while the skin wound was closed. There was moderate tension at the suture line but closure was accomplished satisfactorily. A voluminous pressure dressing was then applied while the hand was held upon the splint in the position of function. X ray check showed satisfactory reposition of the fractures although a loose bone fragment not felt during reduction may require attention later.

There was no febrile reaction following this surgery and the patient was discharged to outpatient status on the third postoperative day. Healing has taken place satisfactorily with probably not quite as smooth a scar as when primary suture is done.

**Secondary Wound Closure**—This case represents the application of wartime experience to civilian practice and is representative of a number of cases seen lately in which at time of initial care primary closure was not deemed safe. If the initial care has been adequate as it was in the case just cited satisfactory closure can be obtained as a secondary procedure. If however the initial care has been inadequate if there are still large areas of necrotic tissue to be removed dead fingers and large hematomas present surgery five to seven days after injury may be very difficult and is much less likely to be satisfactory. At the time of secondary closure we feel that it is possible to secure adequate reduction of fractures by open manipulation through the wound providing it "looks" clean. Nerve and tendon repair, however we would not attempt and strongly advise against it at the time of secondary closure.

What part is played by penicillin in these wounds is difficult to judge. I think we can assume that penicillin has prevented the spread of infection from the wound site so that the problem of serious extending infection has not been a factor. Local disturbances however such as are seen in those cases in which the initial surgery has been inadequate or in those instances in which the wound has been dressed daily and secondary contaminants added are not obviated by penicillin.

If the surgeon elects to perform a secondary closure of a wound it is essential that the primary care of the wound has been carried out with the same meticulousness as if a primary closure were to be done. There must be careful cleansing of the surrounding area then of the wound irrigation of the wound with large amounts of normal saline solution excision of all devitalized tissue and then covering of the wound with a large pressure dressing and the application of a splint. The surgeon is then performing physiological closure of the

wound, i.e., sealing it off from secondary contamination and restoring physiological pressure relations without the danger of locking up potentially pathogenic organisms. At the end of four to five days such adequately treated wounds may be exposed in the operating room and closure accomplished with safety. If, at the time the wound is exposed, necrotic tissue is still present, further excision may be done and after a lapse of another few days closure may be possible. The longer closure is delayed, the less is the possibility that suture can be accomplished because of the fixation of the skin which takes place.

In a way these secondary wound closures have some of the aspects of burns. They resolve themselves into the question of covering raw surfaces, the longer this covering is delayed the more the scar and fixation which takes place and the less happy are the results.

#### CASE VI (PMH No 94522)

has seemed pointless to pursue the question further. Following this he developed marked pain and redness in the hand and forearm and surgical consultation was requested. On transfer to Passavant Memorial Hospital the patient was found to have a moderate elevation of temperature and a white count of 16,450. The left forearm was red and swollen up to the elbow and the hand presented the picture of an extensive infected wound (Fig. 5). There was a large cutaneous defect over

the proximal end of the bone was missing as was also the hamate. There was marked disruption of the carpus. There was evidence of partial median nerve injury. The tendons to the thumb, index and middle fingers seemed to be intact, the extensor tendon to the ring finger was exposed under the necrotic flap, the ring finger flexors seemed to be intact.

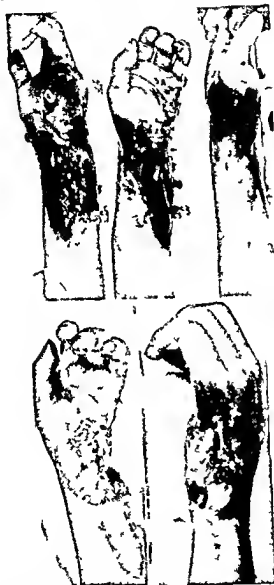


Fig. 5 (Case VI) —Punch press injury to left hand received for treatment five days after injury with spreading infection and gangrene of skin over ulnar side of hand. Two weeks were required to bring the infection under control and to remove gangrenous areas of skin. The wound was then temporarily closed with split grafts. The figures on the left show the hand just before skin grafts were applied two weeks after injury. Subsequently the ring finger was amputated because of loss of the fourth metacarpal and the hand was placed under a pedunculated flap.

viable head, and the bed of the bone covered with a split graft. The head of the bone later became necrotic and separated spontaneously.

The condition of the hand at present is shown in Figure 5. It is apparent, of course, that considerable plastic restoration will be required and has already been started.

**Open Wounds of the Hand Seen Late After Inadequate Initial Surgery.**—This case represents some of the problems which arise in the management of open wounds of the hands seen several days after injury in which inadequate initial surgery has been performed. In these cases a certain amount of spreading infection is nearly always present and must be brought under control before surgery can be performed. The necrotic tissue must be removed either by spontaneous sloughing or by surgical excision as soon as this seems safe. Needless to say the tissue loss will be much greater in these instances than in those cases in which adequate immediate treatment was rendered.

neglected cases remain the same but the exigencies of the occasion require a slower and more cautious approach.

#### CASE VII (PMH No 89269)

This patient was admitted to the hospital on March 15 1946 one hour after

likely that they would separate spontaneously. The patient was discharged to out patient status on the twelfth hospital day. He was readmitted four days later because raw surfaces left by the separation of the small sloughing areas noted above required split grafts.

An early postoperative photograph shows a healed hand with beginning functional return.

The significant features of this case are the severe crushing injury with devitalization of skin and interosseous muscles, and the extensive bony damage of the thumb metacarpus and carpus. Fortunately there



Fig. 6 The universal hand splint is constructed in such a way that the hand rests upon it in the position of function (Allen and Mason from Quart. Bull. Northwestern University Medical School 21:218, 1947.)

was little tendon damage (extensors of 4 and 5 only). Early care, thorough cleansing and excision, reduction of fractures and closure restored the hand to usefulness. Certainly any less extensive procedure, leaving the wound open or a long delay in primary care would have been disastrous.

Value of the "Universal Hand Splint"—The splint is a simple device which is easy to use and which is of great value in the treatment of open wounds of the hand.

of function and which would permit of the reduction of fractures and the application of a pressure dressing. Such a splint has been devised by Dr. Harvey S. Allen and myself and has been extensively tried out in military and civilian practice. This splint is simple in use and is applicable in approximately 90 per cent of all hand injuries. If properly applied the hand lies naturally upon it in the position of function. Fractured metacarpals and phalanges are held in reduction

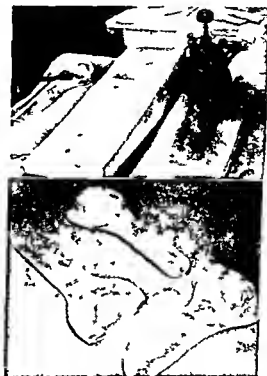


Fig. The splint is hammered out of sheet aluminum over cement mold. (Allen and Mason from Quart. Bull. Northwestern University Medical School 21:18, 1947.)

and the large compression dressing so valuable in the management of injuries may be easily applied to exert uniform resilient pressure over the lower forearm, hand and digits.

The splint is hammered or pressed out of sheet aluminum into a shape to permit either the right or left hand to rest upon it in the position of function (Figs 6, 7 and 8). It should be sterilized so as to be ready for application at the end of the operation. It is covered

with abdominal pads and several thicknesses of gauze dressings, and the hand then laid upon it, taking care that the palm fits snugly against the cup of the splint. Dressings are then placed between the fingers and if fractures are present they are reduced by molding them into position, and then the voluminous pressure dressing is applied and wrapped on snugly.

The splint may be used to advantage in all injuries of the hand except those requiring special positions following nerve and tendon

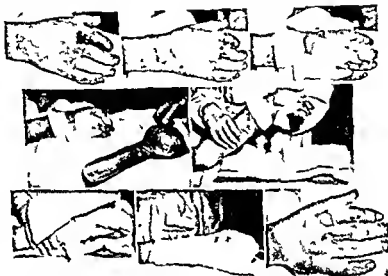


Fig. 8 Illustrates method of application of the universal splint in a burn of the hand. Skin grafts have been applied to burn areas following removal of slough and the hand placed on the splint under a compression dressing (Allen and Mason from Quart Bull Northwestern University Medical School 21:218, 1947.)

repair. It is especially valuable in crushing wounds associated with skin loss requiring skin grafts and compound fractures in which instances the development of a severe edema cannot be prevented unless a compression dressing can be applied. If all injuries of the hand were promptly cared for and immobilized under a compression dressing on a splint such as has been described, it would constitute a major advance in hand surgery.

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## INFECTIONS OF THE HAND

WILLIAM H. REQUARTH, M.D., F.A.C.S.\*

INFECTIONS of the hand are still classified as minor surgery in spite of the fact that the end results obtained may mean almost complete functional loss of the hand. The initial wound is often trivial or the infection appears inconsequential, for this reason, many surgeons feel that anyone should be able to care for an infected hand. For most men the hand is their means of livelihood and loss of its use means loss of income and serious economic difficulties. It is a highly coordinated organ with many structures confined in a narrow space and small abscesses cause damage out of proportion to their size. Early diagnosis and adequate treatment is necessary to prevent harm to these structures which are so important to function.

These infections have been the subject of much thought and study. It is impossible to discuss the subject without acknowledging our debt to Kanavel<sup>1</sup> whose classical study set forth the detailed anatomy and principles of treatment of these lesions. The writer has also drawn extensively on the vast experience of Koch and Mason whose work supplemented that of their predecessor.

### ETIOLOGY

It is estimated that about one half of industrial injuries involve the hand and with certain exceptions most hand infections seen in a general practice follow these injuries. The reason for this is found in the fact that all wounds are contaminated even those inflicted in the operating room. By "contaminated" is meant that one or more groups of organisms are introduced into the wound at time of injury. Most of these are not pathogenic although a few pathogens may be present. During the first few hours they multiply rapidly but usually the body can cope with the initial contamination and the wounds heal cleanly. Hare and Willits<sup>2</sup> examined 244 fresh wounds immediately after injury and found only one with hemolytic streptococcus. Since these organisms are not present to a significant degree at time of injury it follows that they enter the wound at a later date. Meleney<sup>3</sup> has pointed out that the chief source of pathogenic bacteria is the nasopharynx or the contaminated fingers of the attending personnel. The mouth harbors many virulent strains of streptococci which are

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expelled in droplets of spray during talking coughing and sneezing. The staphylococcus is transferred through direct contact by the hands particularly if they have been in recent contact with another infected wound. Thus, if a relatively clean wound is seeded with a large number of pathogenic organisms the body's defenses are overcome and an invasive infection results.

The ability of the body to control contaminants also depends on the local resistance of the tissues. Crushing wounds tend to become infected because severe trauma has decreased tissue resistance. Likewise in the same manner, surgical trauma lowers tissue resistance. The practice of mass ligation of vessels in which much heavy suture material is buried, the use of strong antiseptics and the failure to apply a satisfactory splint to give the wound a chance to heal all swing the balance in favor of the invading organisms. It can be readily seen that the prophylaxis of many hand infections entails such simple measures as wearing a mask over the nose and mouth not touching the wound or dressings with the fingers and gentle and meticulous debridement within the recognized time limit.

Many infections start with no history of trauma but the invading organisms are the same. Williams and Miles<sup>4</sup> examined the bacterial flora of 345 hand infections and found that most of the closed space infections such as the felon and web space abscesses were caused by the coagulase positive *Staphylococcus aureus*<sup>5</sup> and that most open lesions such as the paronychia yielded *Streptococcus pyogenes* as well. Two thirds of the cases of acute suppurative tenosynovitis were due to *Staphylococcus aureus* and the remainder to *Streptococcus pyogenes*, *Escherichia coli* and other types of hemolytic streptococcus were found rarely.

#### GENERAL CONSIDERATIONS IN TREATMENT

First aid treatment is highly important in the prevention of infections. This should consist of more than the simple application of a dressing. A fresh wound constitutes an emergency and needs early closure. In first aid treatment hemorrhage should be controlled with a pressure dressing and not by blind application of hemostats. Whatever definitive treatment is undertaken must be done under aseptic conditions. Most wounds more than eight hours old are no longer clean because the contaminating organisms which are present have already begun to invade the tissues and are beyond the range of wound debridement. Tight closure of a wound twelve to twenty hours old invites infection.

Intelligent treatment requires an accurate knowledge of the anatomy of the hand. The surgeon must have consideration for the many small structures and understand their close anatomic relationships in order to place incisions exactly. The incision and drainage of some hand infections require as careful a dissection of nerve and

tendon as in a traumatic wound Incisions<sup>6</sup> must not damage important structures nor be in the midline or cross flexion creases They should not lead into uninfected areas or areas of active cellulitis The surgery should be done in a bloodless field obtained by applying a blood pressure cuff to the upper arm elevating the arm for a minute to allow venous blood to empty and inflating the cuff to 280 mm of mercury

**Anesthesia**—General anesthesia is recommended Local infiltration with procaine traumatizes tissue spreads infection and when used as a block at the base of the finger may produce gangrene I have seen two such cases one in which procaine and epinephrine were used one in which procaine and a rubber band tourniquet were used Kaufman<sup>7</sup> reports a case of gangrene in which no epinephrine was used and only 2 cc of procaine He reviewed twenty five cases of gangrene following digital nerve block taken from the literature Ethyl chloride spray damages tissue and provides only the most superficial type of anesthesia It has been discarded by most surgeons

### ACUTE SPREADING INFECTIONS

Infections of the hand are divided into two large groups spreading and localized infections and it is of the utmost importance to be able to differentiate between the types since the treatment varies radically

Spreading infections often follow minor injuries<sup>8</sup> the commonest type is the simple abrasion with moderate swelling redness and surrounding cellulitis The process may extend and red lines of lymphatic involvement appear on the forearm and arm with enlarged and tender epitrochlear and axillary lymph nodes The swelling and redness of the dorsum are often marked The temperature is elevated and there is general malaise The fulminating infections characterized by rapid swelling of the entire hand and arm severe pain septicemia and

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tion The patient may insist that something be done but an incision into an area of active cellulitis is strongly contraindicated and can be fatal On the other hand delay in draining a localized infection may permit destruction of tissue with consequent disability of a severe degree Premature incision opens fresh planes of tissue to spread of the infection whereas waiting may run the risk of the infection causing increased destruction The decision requires considerable surgical judgment but one should err on the conservative side

Warm moist heat elevation splinting of the extremity and bed rest are the important local measures The moist heat is provided by a sterile wet dressing comprised of abdominal pads laid on sterile towels and covered with moistened fluffed gauze The hand and arm are placed on the bed of gauze the towels pinned together and the whole

extremity is placed under a heat cradle. It is moistened with sterile saline every four to six hours. Such a dressing remains sterile and no additional micro-organisms are added.

The effectiveness of penicillin and the sulfonamides is greatest in spreading infections because the organism is in the tissues and easily accessible to the drug in the blood stream.<sup>9</sup> After an abscess forms and there is breakdown of tissue with pus and exudate the drugs do not reach the infection as readily and are rendered ineffective by inhibitors present in the wound detritus. Penicillin is preferable to the sulfonamides since it is active against both the staphylococcus and the streptococcus. Best results are obtained when an organism is found in pure culture. Of the invaders, the coagulase-positive staphylococcus is the most susceptible to penicillin.

The recommended dosage of penicillin<sup>9</sup> is 20,000 units every three hours but if the infection is fulminating 100,000 units are given initially. If the response is poor after forty-eight hours the three-hour dose is doubled to 40,000 units but to give more than 350,000 units daily is usually useless. Penicillin in oil does not give sufficiently reliable blood levels to justify its use in such a serious infection.

The local use of penicillin in solution after the drainage of an abscess is not recommended although favorable reports appear in the literature.<sup>10, 11</sup> It is painful, retards the formation of granulation tissue and is reported to cause a heavy growth of coliform organisms in the wound.<sup>12</sup> Meleney has shown that many organisms inhabit

organisms which render topical penicillin ineffective. Meleney states that streptomycin 500 units per cc. or parachlorophenol 0.25 per cent will neutralize penicillinase.

I have had no experience with the local injection of penicillin to abort early infections but have treated several paronychias which had been injected in this manner elsewhere. In all these the inflammatory process had extended, possibly as a result of the trauma of the needle.

#### MINOR SPACE INFECTIONS

For early and accurate diagnosis and localization has occurred and it is wiser to continue conservative treatment rather than risk premature incision. In a felon or acute tenosynovitis early drainage is of such importance that it should be done immediately except perhaps when active lymphangitis is present. The location of the abscess must be known accurately in order to place the incision correctly. This requires thorough and detailed knowledge of anatomy.

**Eponychia and Paronychia**—The forerunner of the subungual abscess (paronychia) is the eponychia (Fig 1, 3), a small bleb of pus alongside the nail with no subungual extension. This is the commonest hand infection usually arising from a "hang nail." If neglected the pus spreads toward the opposite side and burrows beneath the nail to become a subungual abscess (Fig 9, 4). Erosion of the matrix may occur with subsequent deformity of the nail, a sequela which is often blamed on the operation. If neglected further it is possible for the pus to enter the anterior closed space of the distal phalanx and produce a felon.

**Treatment**—The treatment of an eponychia is to evacuate the bleb of pus and cut away part of its roof to insure drainage. It must be

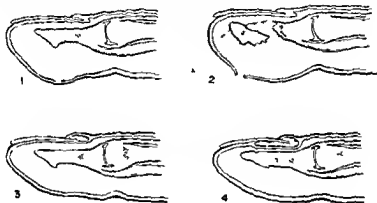


FIGURE 1. Eponychia.

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usually to allow evacuation of subungual abscess or paronychia. The pus has undermined a portion of what must be removed to cure the lesion.

emphasized that this treatment will not cure a subungual abscess and to use it in hopes that more radical measures will not be necessary only prolongs the disability. A subungual abscess is suspected when an eponychia fails to heal or when pain is caused by tapping the end of the nail. Pressure on the nail may cause pus to exude along its margins. Adequate drainage of a subungual abscess is obtained only by complete removal of the proximal one-third of the nail. Two parallel incisions are made extending proximally from the base of the nail; the flap thus formed is elevated and the nail removed. One should be certain that no nail fragment remains.

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**Felon**—This common lesion is more correctly termed an infection of the anterior closed space the small potential cavity which exists in the distal phalanx of each finger (Fig 11 2). Its capacity is small and expansion limited by the thick volar skin bound to the periosteum.

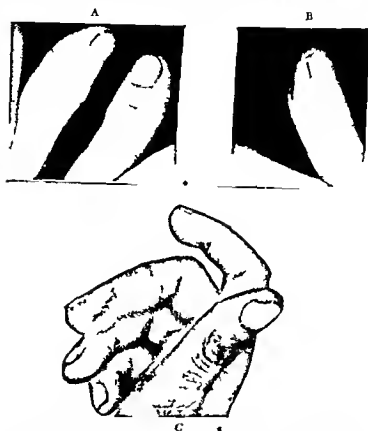


Fig 10 A Felon of left thumb. The swelling is scarcely perceptible. B After incision and drainage. C Felon of middle finger which has extended into subcuticular tissues. Extensive subcuticular infections may be confused with tenosynovitis.

by vertical fibrous bands. Proximally it is closely related to the insertion of the flexor digitorum profundus.

Felons follow puncture wounds, injuries, lymphatic spread from superficial infections, rarely are they a late sequela of paronychia. The pus which is tightly enclosed in a small space produces intense pain and likewise compresses the nutrient artery which traverses the

space and thus predisposes to the development of early osteomyelitis in the shaft. The sheath of the deep flexor tendon is not affected because of a dense proximal partition.

The diagnosis of a felon is based on the characteristic throbbing pain and the presence of a hard, symmetrical swelling limited exactly to the distal phalanx of the finger (Fig 10). Fluctuation does not occur except in the early stage.

to even though the diagnosis is not definite so important is early drainage. The proper incision is on the lateral aspect of the phalanx, carry

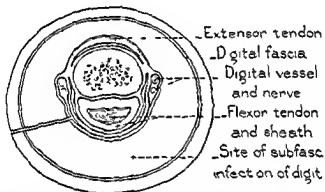


Fig 11—Diagrammatic cross section of subfascial infection in the finger. Redrawn after Kanavel, A. B. and Mason, M. L. *Infections of the Hand*. The Cyclopedia of Medicine. F. A. Davis Co. Philadelphia.)

finger the so-called "fish mouth" incision. This will produce a tender sensitive scar.

The failure to achieve a good result is usually due to treatment which was "too little and too late." Bone involvement occurs in nearly all cases and ranges from periostitis to severe osteomyelitis with sequestration of the entire shaft. As Koch<sup>13</sup> points out, osteomyelitis in the hand is secondary to soft tissue abscesses and responds best to simple drainage of the abscess. Scraping the bone only carries the infection deeper and should not be done. As sequestra separate, they should be lifted out of the wound.

**Digital Subfascial Infection**—This infection is frequent and is important because it is often confused with tenosynovitis. The digital fascia envelops the finger and is continuous proximally with the palmar fascia. Pus collecting under this fascial layer quickly spreads



up and down the entire finger, may extend into the palm and web space and occasionally invades the tendon sheath (Fig 11)

The finger is uniformly swollen, semirigid and diffusely tender. Extension causes pain and the picture may exactly simulate acute tenosynovitis. However, if seen early the swelling is localized, the tenderness is not limited to the tendon sheath and if the middle and proximal phalanges are fixed and the distal phalanx alone extended, no pain will result. This same procedure causes exquisite pain in acute tenosynovitis and is a valuable method of differentiating the source of pain on extension of the finger.

*Treatment*—Positive differentiation may be made only at operation. The incision for drainage is the same as that for tenosynovitis, placed



Fig. 12—A Web space infection or collar button abscess which originated in an infected callus. Abduction of finger is characteristic. B Marked edema of dorsum caused by relatively small abscess. C, After drainage.

along the lateral aspect of the finger just dorsal to the extreme margin of the digital flexion creases. The digital nerve is retracted dorsally, the fascia incised and the pus evacuated. Performed in a bloodless field, the tendon sheath can be carefully inspected and opened if there is evidence of tenosynovitis.

**Web Space Infection**—The interdigital spaces lie directly beneath the palmar fascia, contain much loose areolar tissue and communicate directly with the dorsum. Pus spreads quickly to the dorsal subcutaneous space.

Most of these begin as an infected callus with first a subcuticular abscess which extends through the fascia to produce an abscess in the areolar tissue of the web (Fig 12). These are sometimes called

"collar button" abscesses because of the two pockets connected by a narrow channel

The distal portion of the palm is tender and swollen and there is a hard indurated mass in the web which holds the adjacent fingers in extreme abduction. Drainage is obtained through a transverse in-

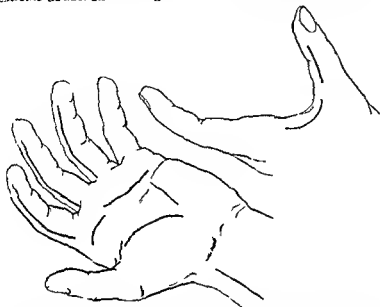


Fig. 13—Lines of incision for draining web space infections, sheath infections, middle palmar, thenar and retroflexor spaces. Incisions must not cross flexion creases nor be in the midline. They must not damage important structures nor lead into uninfected areas.

cision over the abscess in the distal part of the palm (Fig. 13). A vertical incision which divides the web is not advisable and produces a wound which heals slowly.

### MAJOR SPACE INFECTIONS

**Middle Palmar Space Abscess**—This space lies deep in the palm<sup>14</sup> on the metacarpal bones and interosseous muscles bounded on its radial aspect by a septum<sup>15</sup> which extends from the center of the third metacarpal bone to the palmar aponeurosis and on its ulnar side by the hypothenar muscles. The flexor tendons of the third, fourth and fifth fingers cover the palmar space. Distally it is divided into many small compartments by multiple fibrous septa extending vertically downward from the palmar aponeurosis. Primary infection of the midpalmar space is unusual but may occur after puncture wounds and similar injuries. The commonest source of infection is

the human bite wound of the dorsum which extends down the lumbrical canal into the palm. Neglected sheath infections of the third and fourth fingers occasionally rupture into this space.

In early infections there are few signs except for tenderness in the palm and some pain on extension of the fingers. Later, the palmar concavity is obliterated, the palm assuming a thick, flat contour with

extended

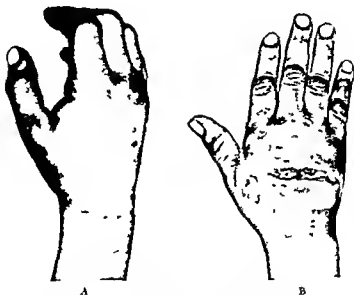


Fig. 14—A, Dorsal subaponeurotic space infection following needle wound. B After drainage. (Case of Dr. Everett Nicholas.)

**Treatment**—The middle palmar space is drained through a transverse incision in the distal part of the palm parallel to the distal palmar flexion crease. The operation should be done in a bloodless field and with great care to avoid injury to the digital nerves and flexor tendons which traverse the line of incision at right angles.

**Thenar Space Abscess**—The thenar space is separated from the middle palmar space by the adductor of the index finger. The sources of infection are puncture wounds of the radial palmar space or rupture of

a neglected sheath infection of the index finger and less often of the middle finger

The characteristic feature of thenar space abscess is the balloon like swelling of the thenar region which holds the thumb in extreme abduction. The index finger is semiflexed and attempts to extend it cause pain. As in other major infections of the hand there is marked edema of the dorsum. The diagnosis is not always easy, inasmuch as cellulitis in this region causes a similar picture although without abduction of the thumb.

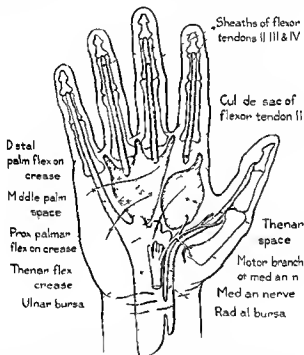


Fig. 15—Diagram to show the relationship between the tendon sheaths, radial and ulnar bursae, middle palmar space, thenar space, and motor branch of median nerve.

**Treatment**—The space is best approached through an incision on the dorsum of the web. The first interosseous muscle is retracted and a forceps thrust through the fibers of the adductor pollicis muscle.

**Acute Tenosynovitis**—The flexor tendons lie in fibrous tunnels which bind them to the volar surface of the phalanges and prevent

They are lined  
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the human bite wound of the dorsum which extends down the lumbrical canal into the palm.<sup>29</sup> Neglected sheath infections of the third and fourth fingers occasionally rupture into this space.

In early infections there are few signs except for tenderness in the palm and some pain on extension of the fingers. Later the palmar concavity is obliterated, the palm assuming a thick, flat contour with marked edema of the dorsum. The region is exquisitely tender with the fingers held semiflexed. Since the tendons of the middle, ring and little fingers overlie the abscess, there is marked pain when these are extended.

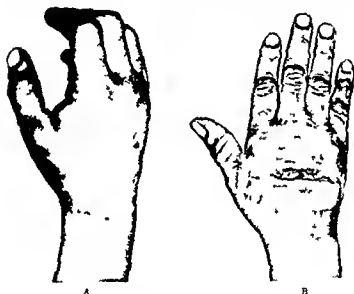


FIG. 14. A Dorsal subaponeurotic space infection following needle wound. B After drainage. (Case of Dr. Everett A. Chelius.)

**Treatment**—The middle palmar space is drained through a transverse incision in the distal part of the palm parallel to the distal palmar flexion crease. The operation should be done in a bloodless field and with great care to avoid injury to the digital nerves and flexor tendons which traverse the line of incision at right angles.

**Thenar Space Abscess**—The thenar space is separated from the

middle space and is separated from the radial portion of the palm or rupture of

lymphangitis is present. The index, middle and ring finger sheaths are opened through incisions placed along their lateral aspects as described under subfascial infections. The sheath is widely opened

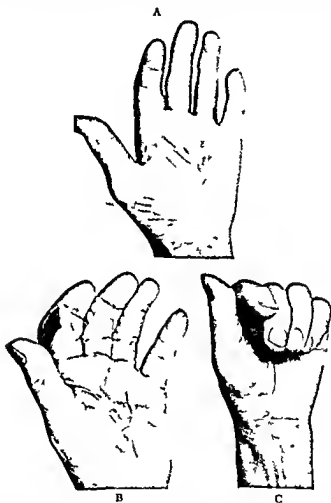


Fig 16—A Acute tenosynovitis five days after incision and drainage. The patient was seen early. B and C Healed showing degree of function retained. (From Requaarth, W. H. *Diagnosis and Treatment of Localized Infections in the Hand*. U. S. Nav. M. Bull., vol 46.)

A second incision is always made transversely in the palm to drain the cul-de-sac.

In sheath infections of the thumb and little finger the surgeon

ring fingers end in a blind pouch in the palm at a level of the metacarpophalangeal joints, a point which corresponds to the distal palmar flexion crease if projected into the palm. Pus tends to gravitate to this blind pouch, called the cul de sac, and may rupture into the thenar space if the index sheath is involved or into the palmar space if the ring finger sheath is infected. The sheath of the middle finger usually ruptures into the palmar space but can also involve the thenar space.

The sheath of the flexor tendon of the thumb extends proximally to the wrist but enlarges in the palm to form the radial bursa (Fig 15). The flexor tendon of the little finger likewise extends to the wrist and also enlarges in the palm, this portion being called the ulnar bursa which encloses the flexor tendons at the wrist. The two bursae usually communicate with one another so that it is possible for an infection in the distal part of the sheath of the little finger to extend to the sheath of the thumb. Pus under tension in these bursae will rupture into the retroflexor space, an area between the pronator quadratus and the flexor tendons, and from here may extend up the forearm.

Fortunately, acute suppurative tenosynovitis is relatively uncommon when compared with other hand infections. It is usually secondary to puncture wounds, tooth wounds or neglected infections in the fingers. It rarely occurs after injuries even though the sheath is opened and the wound later becomes infected.

The classical symptoms were described long ago by Kanavel<sup>1</sup>: semiflexion of the involved finger, diffuse uniform swelling, tenderness along the sheath and pain on extension. There is a moderate systemic reaction with elevation of temperature. As stated previously, however, the diagnosis is sometimes difficult and is often confused with subfascial infections of the digits. Almost any infection of the finger will cause pain on extension and care must be taken to immobilize

16)

The prognosis depends on duration of infection, sheaths involved and type of organism. Early drainage is of extreme importance and as in the case of a felon, incision is an emergency procedure. Damage to the tendon occurs early and even though minimal renders the prognosis poor. The staphylococcus is more destructive than the streptococcus and therefore, if the former is the invading organism the outlook for return of function is poor. The outlook is better when the other sheaths are involved in the radial and

*Treatment*—Immediate drainage is imperative unless an active

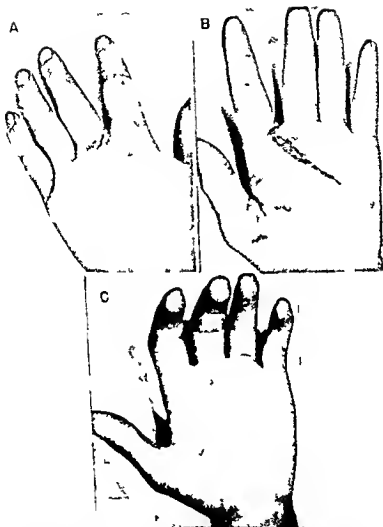


Fig. 17—A Lacerated wound over knuckle caused by striking tooth in fist fight. The joint was not involved initially. The infection has spread proximally into the subaponeurotic space and volarward to the palm via the limbrical canals. B Single incision which allows drainage of web space and middle palmar space. C Healed. No impairment of function. (From Research W. H. Diagnosis and Treatment of Localized Infections in the Hand U. S. Nav. M. Bull. vol. 46.)



should incise uninvolved areas first. For example, A patient injures his thumb, later has evidence of tenosynovitis of the thumb with slight tenderness over the ulnar bursa and sheath of the fifth finger. It is possible that no pus will be encountered in the ulnar bursa so it is incised first through a vertical incision of the palm along the border of the hypothenar muscles. If the sheath is not involved, the wound is covered and the sheath of the thumb flexor is opened through an incision along the ulnar aspect of the thumb and carried proximally to skirt the thenar eminence. The motor branch of the median nerve lies directly in the path of such an incision and must be scrupulously avoided. The retroflexor space is always drained; radial and ulnar bursa infections even though there is no evidence of pus in that region. It is easily entered through a short incision just volar to the flat surface of the radius at the wrist. A hemostat inserted beneath the flexor tendons close to the radius will enter the retroflexor space on top of the pronator quadratus muscle.

A frequent complication of tenosynovitis is necrosis of the tendon with subsequent prolonged drainage. The wound may heal except for several sinuses which continue to drain. Necrotic tendon is a foreign body and acts exactly as a bone sequestrum in prolonging healing. Tendon should be removed as soon as it is known to be necrotic.

### HUMAN BITE INFECTIONS

Experience has shown that wounds contaminated with human mouth organisms are very dangerous and produce the most destructive infections seen in the hand.<sup>16, 17</sup> The functional disturbances which result are most serious and often cannot be avoided in spite of a wide variety of organisms. Infection is caused by the organisms living in symbiosis under anaerobic conditions in the mouth.

Patients often recovered from the wound. Because of the bacterial flora of the human mouth these wounds are much more serious than the tooth wounds of an animal.

More than fifteen years ago Mason and Koch<sup>20</sup> published an accurate anatomic account of the routes of spread of human bite infections and at the present time nothing further can be added to this contribution. All who have occasion to treat these infections should read their paper in detail. The majority of bite wounds occur over the knuckles, the result of a fist fight (Fig. 17). The extent and depth of the injury foretells the course of the infection which follows.

discharge was remarkable Allen <sup>1</sup> states however that the drug has not changed the outlook in those cases in which there is suppurative arthritis. There was no joint involvement in any of my cases. After three days the warm moist dressings are discontinued.

A most important phase of treatment is the detection of extension. At first this occurs laterally in the soft subcutaneous tissue of the dorsum but the pus soon moves distally along the side of the finger to the lumbrical canal and palm. Each day the surgeon must examine the palm for tenderness and the first sign of midpalmar space infection is an indication for incision and drainage of this region. It is most important that this be done early to avoid destruction of the flexor tendons.

Neosphenamine has been used but is not effective. Zinc peroxide when used exactly as Meleney <sup>2</sup> advises will decrease the foul odor and help arrest infection but with the advent of penicillin it does not occupy the prominent place in treatment that it once held. As the infection begins to subside excision of necrotic tissue especially tendon is important to avoid prolonged drainage.

### POSTOPERATIVE CARE OF HAND INFECTIONS

There is confusion and controversy concerning the proper use of drains in the hand. The only purpose of a drain is to hold the skin edges apart in order that pus may escape.<sup>3</sup> It should not be packed into the wound to act as a stopper and should be removed in twenty four to forty eight hours and not reinserted. Repeated reinsertion of a drain causes a foreign body reaction. Petrolatum gauze or any non-adherent greasy gauze is satisfactory as a drain. Rubber tubes are especially harmful and if placed as through and through drains often erode nerve and tendon by pressure. The surgeon must remember that drainage is obtained by the incision and not by the material placed in the wound postoperatively.

Warm moist sterile dressings are chiefly valuable when there is still cellulitis present. After incision of an abscess such a dressing is kept on for two or three days but if used longer the skin becomes white and macerated and loses its resistance to bacterial invasion. At this time the hand should be soaked twice daily in warm sterile water dressed with dry gauze and immobilized on a splint. To tell a patient to go home and soak his hand "dressing and all" is the mark of extreme ignorance.

Many physicians have the erroneous idea that since an abscess has been opened the area is already infected and *aseptic technique* is useless. As a result other contaminants are added and more destruction occurs. Dressings should be changed with strict observance of *asepsis*; fingers kept out of the wound and dressings handled with forceps. A mask should cover the nose and mouth. To carelessly remove a dressing, inspect the wound and paint it with an antiseptic shows

carpophalangeal joint can easily injure the extensor tendon open the joint and even damage the bone. When the fingers are extended the wound of entry glides proximalward with aponeurosis and carries organisms into a clean closed area. Conditions are then ideal for anaerobic growth.

Inability to extend the finger completely indicates that the extensor tendon has been damaged and one can assume that the joint has been contaminated if the wound is located over the joint. This is an extremely grave prognostic sign since suppurative arthritis, osteomyelitis and ankylosis invariably follow. In other cases the infection may be confined to the subaponeurotic space and remain extracapsular but will tend to spread distally beneath the expansion of the extensor tendon, move around the finger toward the volar surface and down the lumbrical canal into the palm. The middle palmar space is nearly always invaded although the flexor tendon is spared due to its dense fibrous sheath. The extensor tendon, however, is bathed in pus and may be destroyed early.

Bite wounds of the fingers are less serious than those over the metacarpophalangeal joints but the infection is just as invasive and destructive as elsewhere. Felons and tendon sheath infections are the most serious complications of wounds in this region.

The onset of a bite infection is usually rapid and within twenty-four hours the area is red and swollen. A grayish, watery discharge appears first and has a very foul odor. Pain is prominent and aggravated by the slightest degree of motion; the temperature is elevated. Seemingly trivial wounds may be extremely serious. For example, a man observed by me received a small deep bite wound of the dorsum which was followed by an acute invasive infection with cellulitis, septicemia and death six days after injury. As the infection progresses gangrene of the superficial tissues ensues and a large amount of thick, putrid pus exudes from the wound. Tenderness and pain in the palm indicate infection of the middle palmar space.

**Treatment**—The treatment of a superficial abrasion consists only in cleansing with soap and water and immobilization on a splint. Under no circumstances should these wounds be closed even though it is a temptation to suture what may appear to be a clean laceration. As Koch<sup>20</sup> points out, all wounds in this area should be considered bite wounds until proved not to be, since patients often deny their true origin.

After proper cleansing, the wound should be debrided under a general anesthetic and all devitalized tissue removed. The hand is put on a splint in the position of function and warm moist dressings are applied. Penicillin is started immediately in massive doses and has a marked effect on the course of the infection. I have had an opportunity to treat only a few such cases since the war but in these the ability of penicillin to arrest the infection and clear up the foul





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lack of training and sheer laziness. The dye stains the skin and hides evidence of extension or retention of pus. Remarkably good results are obtained by simple cleanliness (with soap and water) and daily debridement of devitalizing tissue.

The importance of rest has been emphasized time and again by Koch<sup>13</sup> but it is a difficult lesson for most surgeons to learn. Injured tissues must be immobilized to promote healing and decrease pain. Proper splinting<sup>14</sup> is a major factor in successful treatment. On the other hand, as soon as the infection subsides active motion should be started and it is necessary only to put the joints through a full range motion once a day. During the time the hand is on a splint, it is held with the wrist slightly extended and the metacarpophalangeal joints flexed to 90 degrees. If the proper position for grasp assumes a flat and boardlike position, certainly the ultimate goal of treatment, is forgotten in the surgeon's anxiety to attend the details of treatment.

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the first week of life or in adults with a genital infection. We have seen it more often in doctors and nurses caring for infected patients.

There is a purulent profuse yellow secretion with a boardlike swelling of the lid skin so severe that the lids cannot be separated. The gonococcus is seen in smears and cultures.

Large doses of penicillin and local irrigations with penicillin give prompt relief with minimum complications. 2500 units per cc. one drop hourly for twenty four hours then every two hours has been advised.

**Pterygium**—Pterygium is a thin conjunctival tissue loosely attached to the cornea at its apex which may lie at the limbus and remain stationary or may grow toward the center of the cornea or even across it and thus impair vision. If it is progressing onto the cornea it should be removed. It is usually seen on the nasal side but may be on one or both sides of both eyes.

**Technic of Operation**—The McReynolds operation is simple and effective. A double armed silk suture is placed at the apex of the pterygium. A very sharp scalpel is used to cut the apex free from the cornea cutting deep enough and far enough to be certain to get a tiny bit of normal cornea beyond the apex. The freed portion is lifted away from the cornea. A 1 cm. incision is made in the conjunctiva near the base of the pterygium and through this incision the needles are introduced beneath the conjunctiva and brought out 1 to 2 cm. away toward the lower fornix where they are tied. The base of the pterygium fills the defect made by the incision and usually requires no sutures. An antiseptic ointment is used in the conjunctival sac and the eye is bandaged. The suture is removed five to seven days later.

### DISEASES OF THE EYELIDS

**Lid Infections**—A *stye* or *hordeolum* is an acute inflammation of one of the glands of Zeiss or Moll. The redness and swelling appear in the lids adjacent to the lash line. Later a yellow point appears at the base of or between the roots of the cilia. In severe forms, the lower cheek may be severely swollen, red, the skin tense and the preauricular gland on the involved side may be enlarged and tender. There is usually a rise of a degree or more in body temperature with such an infection.

During the stage of redness and swelling, hot compresses using a wash cloth to hold the heat which should be applied for fifteen to twenty minutes four times a day is the best treatment. Aspirin usually relieves the pain.

When the stye points (yellow spot appears at the apex of the swelling) it may be incised with a thin bladed knife (a cataract knife is ideal) or a sharpened wooden toothpick, dipped in 95 per cent phenol may be used to open it. Hot compresses followed by slight pressure toward the lash line will keep it draining. Metaphen oint



## MINOR SURGERY OF THE EYE

LOUIS BOTTMAN, M D, F A C S \*

This paper is not intended for the ophthalmologist, but for the general practitioner or industrial surgeon who is confronted with eye problems in his daily practice

### DISEASES OF THE CONJUNCTIVA

**Acute Purulent Conjunctivitis.**—Acute purulent conjunctivitis is usually an infection with various types of organism. Silver nitrate has

to neutralize the silver nitrate. We have almost discontinued the use of this drug as we have found that the irritation may prolong the infection or at least the convalescence and silver nitrate can produce a superficial keratitis which produces more annoying symptoms than conjunctivitis. In recent years drops or ointments of the sulfa drugs and penicillin have been used. We have seen too many local allergic reactions from both medicaments and reserve their use for the cases of infection by known drug sensitive organisms.

It is much safer and the results are almost equally as good if one will combat most cases of acute conjunctivitis which should clear in from five to seven days.

**Allergic Conjunctivitis.**—A more common form of conjunctivitis is the allergic form which is recognized by the velvety appearance of the conjunctiva, large follicles in the fornix and the injection of the conjunctival vessels with mucous secretion. The more severe form is the large pavement block type of conjunctivitis. The plaques on the upper tarsal conjunctiva (vernal conjunctivitis), may have a white stringy or mucoid secretion. For marked secretion, Gifford advised a 3 per cent sodium bicarbonate solution. Gold compresses and a 2 per cent pyribenzamine solution give some relief.

**Gonorrheal Conjunctivitis.**—This may be seen in infants within

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ficial incision parallel to the lid border over the center of the swelling. If this is not done it may be difficult to locate a small swelling after the injection of the skin. A 2 per cent novocaine solution is injected beneath the skin over the swelling infiltrating widely enough to prevent pain from pressure of the chalazion forceps. If this is done the operation is painless. The pressure of the forceps makes the operation bloodless.

After the clamp has been placed the incision is made in the center of the swelling parallel to the lid border cutting through the tarsus. A yellowish pus serum or cheese like material appears when the sac is entered. The incision is enlarged by removing a 1.5 to 2 mm. piece of tarsus on each side of the incision. A chalazion curet is used to clean out all of the contents of the sac. The smooth glistening sac remains. If an opening is left the conjunctiva will grow into it and there can be no recurrence. Considerable bleeding occurs when the clamp is removed. This will cease after a few minutes. The clots are removed with a cotton applicator and an antiseptic ointment instilled into the conjunctival sac. A light bandage should be placed over the eyes. This may remain from four to twenty four hours. Warning is given not to use a pressure bandage particularly on a chalazion of the upper lid. We have seen a corneal erosion and ulcer follow the use of a bandage that was too tight.

**Molluscum Contagiosum**—This lesion which is due to a filtrable virus originates in the sebaceous glands of the lid giving rise to a proliferation of the walls of the ducts with a keratinization of the central cells. The waxy nodules from pinhead to split pea size have a characteristic umbilication. If they are near the lid margin there is an associated conjunctivitis.

An incision parallel to the lid margin with expression of the waxy or cheesy material is sufficient to cure this condition.

**Milium**—Milium is a minute wheat grain like lesion of the sebaceous glands of the lid skin. An incision with expression of the cheesy material is usually sufficient. Occasionally the material may have the consistency of chalk.

**Xanthoma or Xanthelasma**—These are yellowish or orange plaques in the lid skin which involve usually the lids of the inner angle but may cover the entire lid skin. The lesions are benign collections of cells containing fat and lipochrome. They may be removed surgically. A small area of normal skin around the lesion should be included when operating. The adjacent skin should be undermined and closed with fine sutures which avoids scarring. The lesions may recur. Radium or diathermy may be used in the treatment.

**Papilloma**—Papillomas are flat or pedunculated tumors frequently seen on the lid borders. If pedunculated an oval incision around the base parallel to the lid margin should be made the tumor excised the adjacent skin undermined and the wound closed with very fine

ment may be used along the lash line after the hot compresses. Styes are prone to occur in diabetics and with conjunctival allergies.

**Blepharitis**—This is an inflammation of the lid border involving the lash line and is associated with conjunctivitis. It may be infectious or on an allergic basis. Refractive errors are only indirectly responsible for this condition as well as for styes and chalazia. Patients with high degrees of astigmatism or hyperopia have blurring and burning, and are prone to rub the eyes with dirty fingers and thus traumatize the meibomian gland openings and cause chalazion or carry infection to the lids and produce blepharitis or styes. In such patients glasses to correct refractive error may reduce the incidence of lid infections.

Treatment consists in the use of absorbent cotton dipped in luke warm boric solution or olive oil, daubed on the crusts (not rubbed) to soften them so that they can be wiped off without causing bleeding or loss of the cilia. This should be done every night. Metaphen ointment may be used morning and night. X ray in one third erythema doses often give relief. Obstinate cases associated with folliculosis of the conjunctiva are usually allergic and may require the care of an allergist for permanent relief. A 2 per cent pyribenzamine ointment frequently alleviates the itching.

**Chalazion**—A true chalazion is a granuloma of a meibomian gland and not a cyst. A section of such a tumor resembles a tubercle and is usually so diagnosed by the general pathologist. It is due to the closure of the mouth of the gland. The sebaceous material retained causes a chemical irritation to the surrounding tissue. Clinically it appears as a round or oval swelling under the skin of the lid and grayish red on the conjunctival surface when the lid is everted. If the tumor is soft, it is best treated with hot compresses for thirty minutes followed by three or four minutes of massage. The massage is done with the forefinger of the thumb and stroking firmly over the skin of the lid.

If the tumor is large enough to cause symptoms, it may be removed. In such cases, surgery is necessary. If the tumor is large enough to cause no symptoms, it may be permitted to remain without any danger to the patient. If it is large enough to produce a pseudoptosis or to be disfiguring, it should be removed.

**Surgery of Chalazion**—Two or three drops of 4 per cent cocaine suffices to anesthetize the conjunctiva. If the chalazion is small, it is well to mark its exact site on the conjunctiva by making a super

ficial incision parallel to the lid border over the center of the swelling. If this is not done it may be difficult to locate a small swelling after the injection of the skin. A 2 per cent novocaine solution is injected beneath the skin over the swelling, infiltrating widely enough to prevent pain from pressure of the chalazion forceps. If this is done the operation is painless. The pressure of the forceps makes the operation bloodless.

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sutures If the lesions are on the lid border, coagulation with diathermy is the better procedure

**Carcinoma**—This lesion usually seen on the skin near the inner canthus, is a basal cell or squamous cell type If the skin with the tumor is freely movable, the tumor may be removed Some adjacent normal skin should be taken with the tumor The incision should be horizontal-oval to prevent contraction with eversion of the lid The adjacent skin should be undermined and the incision closed with fine

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lowed by plastic repair may be necessary Superficial lesions may be treated with radium but it is perhaps safer to use radium after excision of the tumor

**Ectropion**—Ectropion is a condition in which the lower eyelid is everted exposing the conjunctiva which becomes red and dry There are two forms cicatricial and noncicatricial The former, which is due

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and tied firmly over a piece of rubber tubing or a roll of gauze By the globe The

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flaccid lid skin causes eversion of the lower punctum which causes tearing Cold compresses with gentle but firm massage toward the

causes irritation lacrimation and redness of the nasal one fourth or one half of the bulbar conjunctiva The condition is readily recognized as there is a sharp vertical line of demarcation between the normal bulbar conjunctiva and the injected nasal portion The cilia are usually in the upper lid punctum—very rarely in the lower They are easily grasped

Lacrimation may be due to  
angle of the lids—usually the  
opening with a thin dilator and

the use of increasingly larger doses up to a No 6 The punctum should first be touched up with some powdered or crystal cocaine to

prevent pain. Any deeper probing such as dilating the lacrimal canals or the inner opening of a tear sac should be left to an ophthalmologist.

**Spastic Entropion.**—Entropion can be cicatricial as is seen with trauma or trachoma, or it may be spastic as seen in the aged. The former requires plastic surgery.

In spastic entropion, inversion of the lower lid causes scratching of the bulbar conjunctiva and cornea which produces pain, redness and tearing.

The use of adhesive tape to pull the lid away from the globe rarely gives permanent relief. Such relief can be obtained by the use of cautery.

**Method.**—The skin of the lower lid is sterilized with soap and water and/or 70 per cent alcohol. A drop or two of 4 per cent cocaine is placed in the conjunctival sac. The lid is well injected up to its upper margin with 2 per cent novocaine solution. The cold tip of a 3 to 5 mm wide electrocautery is placed in the middle of the lower lid 2 to

tant from the first puncture and the outer canthus and the first puncture and the second puncture are made with the electrocautery.

a week leaving almost imperceptible scars and a lid that is in normal position.

### TRAUMA

**Eyelids.**—The skin of the eyelids is so loose that a minor blow or an insect bite can produce an edema severe enough to cause the eye to be "swollen shut." A few drops of adrenalin injected into the lid and ice cold compresses may reduce the swelling if seen very early. Cold compresses are indicated the first twelve hours, but after this period hot compresses should be used.

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levator of the upper lid is cut producing a ptosis (recognized by the inability to open the eye without wrinkling the forehead) or the trauma is very extensive, it is far better to put on a dressing if the patient can be gotten to an ophthalmologist within twenty-four hours. You may save the patient a second or even more operations later.

*Emphysema* of the lids may follow fractures into the paranasal sinuses. The crackling noise on pressure makes the diagnosis easy. No treatment is necessary. The air is absorbed rapidly.

Burns to the skin of the lids are treated like any other burn except that medication which might irritate the eyes should be avoided if there is any danger of its getting into the conjunctival sac.

Glass fragments from spectacles may become deeply embedded beneath the skin of the lids or the cheek. They may become encapsulated and form firm, elevated nodules, tender on pressure. They are easily removed through a small incision which may not even require a suture.

**Conjunctiva.**—Subconjunctival hemorrhages may occur from rubbing, coughing, sneezing or a blow, but they may also occur spontaneously. They may vary from a few millimeters in diameter to involve the entire globe. Small ones require no treatment and may undergo absorption in a few days. Large ones if associated with large hematomas may require removal of as much of the clotted blood as possible and, if the hemorrhage is very recent, cold compresses are used. If it is more than twenty-four hours old, hot compresses may hasten absorption.

**Lacerations.**—For tears in the conjunctiva, if the lips of the wound are separated only a few millimeters, an antiseptic ointment and a light bandage are sufficient. If the conjunctiva is widely separated, it should be sutured, using fine silk sutures. If the conjunctival defect is in the lower one half and extensive, a cicatricial entropion is less likely to be the result if the defect is closed so that the line of suture is vertical. The conjunctiva can be safely and easily undermined to bring the edges together. Effort should be made to avoid wrinkling and "teet-like" projections which may form cysts. The latter can easily be snipped off when they occur.

**Perforating Injuries of the Globe.**—Perforating injuries of the globe are always serious and their care is relegated to an ophthalmologist.

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drops of 4 per cent cocaine. The conjunctival sac is irrigated with  
the lips of the wound are gently  
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solution to  
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the corneal wound, a conjunctival flap must be pulled down from  
above. The conjunctiva is incised from eight to four o'clock at the  
limbus and undermined as widely as possible, using the blades of a  
scissors to separate it from the sclera and Tenon's capsule. When it is  
free enough to be pulled down almost to the lower limbus a suture

is fixed to the flap at ten o'clock and into the intact conjunctiva below eight o'clock and another at one and four o'clock and the sutures are tied. This will cover the cornea and the sutures will hold for four or five days sufficiently long for the wound to heal. They may come loose or may be removed after five days when the conjunctiva will slip back to its normal position. If the iris cannot be replaced it should be pulled out slightly and snipped off allowing the remainder to retract into the anterior chamber. The conjunctival flap is then prepared as just described.

If the puncture wound is in the sclera the conjunctiva over the area should be opened and undermined so that it can be readily closed. One or more mattress catgut sutures should be placed in the sclera and tied while the choroid is being depressed with a spatula. The conjunctiva should then be closed with fine silk sutures. If in such a case the incision is large with choroid and vitreous prolapsed and the former cannot be replaced the situation is much more serious. It may be necessary to snip off the prolapsed choroid or ciliary body which increases the danger of sympathetic ophthalmia. Such a case must be carefully observed for signs of uveitis. Anterior uveitis (iritis) is a familiar picture but cyclitis and choroiditis are not so readily recognized. With such a severe trauma persistent lachrimation circum-

the symptoms persist for six weeks. It may be too late to wait until the normal eye develops irritation though we have seen complete recovery following enucleation of the injured eye after the second eye had developed iritis and the enucleated eye showed the pathological picture of sympathetic ophthalmia. It is much safer to remove a blind irritated eye especially in a child than to risk a sympathetic involvement.

Enucleation and not evisceration is the operation of choice.

FIG. 11.

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remed. Atchmann should not be used in diabetes or glaucoma. Corneal foreign bodies should not be wiped off with an applicator lest the epithelium be denuded and the symptoms aggravated. A drop of 4 per cent cocaine gives good anesthesia. We have seen only one instance of a toxic reaction to cocaine in twenty five years.

A flat corneal spud with a rounded sharpened end is the safest instrument to use. With a Beebe loupe a good light (in a dark room) removal of most foreign bodies can be done quickly and with little or no trauma to the cornea. The flat blade of the eye spud is placed





their treatment. This is 20 per cent dimercaptopropanol in thiodiglycol and should be employed within twenty five minutes after the accident. If it is not available a 2 per cent sodium bicarbonate solution may be used to irrigate the eye.

**Ultraviolet Light**—Excessive exposure to such light causes severe burning and lacrimation and sometimes pain of the cornea due to exfoliation of the corneal epithelium. Cold compresses and a 2 per cent holocaine solution as drops give relief. The use of infra red light through the closed lids has also been used to shorten the convalescence. As a rule no permanent damage occurs unless the exposure is prolonged. In such cases cataracts or macular edema followed occasionally by a cyst and a hole in the macula may occur and cause marked reduction in central vision.

### SERPENTIC ULCER OF CORNEA

The serpentic ulcer is an infectious type of ulcer usually produced by the pneumococcus or streptococcus. It not infrequently follows foreign bodies or chronic dacryocystitis. The lesion is always accompanied by severe circumcorneal injection and hypopyon. Treatment must be immediate for an eye may be lost in twenty four hours.

Intravenous typhoid vaccine in doses of 100 million repeated in twenty four hours if the temperature has returned to normal should be instituted at once. Penicillin and sulfa drugs as usually given have not been effective. Anterior chamber irrigation with penicillin has been of some value as have subconjunctival injections. Local irrigations with 2500 units per cc of penicillin must be used regularly twenty four hours daily for any effect. Delimiting keratotomy, that is a through and through cut in the cornea immediately ahead of the advancing ulcer has been of great value in combating the infection. Atropine sulfate 1 per cent solution four times a day, and hot compresses should be employed. In spite of all treatment a panophthalmitis may develop. If this occurs an exsiccation with removal of the contents of the sclera should be done. Enucleation is dangerous in such cases.

The operation is painful and is best done under sodium pentothal anesthesia. An incision is made at the limbus and the cornea removed. The contents of the globe are scooped out and a piece of gauze wound around a finger used to scrape thoroughly all parts of the sclera to make certain no visible pigment remains. The sclera can be easily inspected if the cornea is removed. If it is cut horizontally this cannot be done well and pigment may remain. Three interrupted sutures draw the sclera lips together yet permit drainage. Antiseptic ointment is used in the conjunctiva and the eye is bandaged.

## MINOR SURGERY OF THE NECK

L. W. PETERSON, M.D., F.A.C.S.\*

In no other part of the body has minor surgery such potentialities for becoming major surgery during the course of operation, as in the neck.

The neck is a muscular tube which is supported by the cervical vertebrae, and which surrounds the vital viscera, encloses the great vessels and nerves, and contains glands with extremely important functions. Knowledge of the anatomy of the neck, with its muscular, bony and cartilaginous landmarks and important fascial planes, and accuracy of diagnosis are the two most important prerequisites for performing any surgery of the neck. Diagnosis is usually established by an accurate history, careful physical examination, knowledge of the pathologic processes occurring in the neck, and laboratory data. Occasionally, the correct diagnosis is made only in the laboratory of the surgical pathologist.

Minor surgery of the neck can be divided into three sections: (1) injuries, (2) infections and (3) tumors.

### INJURIES

**Lacerations.**—The neck, because of its relatively small size and the protected position it occupies between the head and shoulders, sustains few injuries, excluding the group of injuries which are self-inflicted. In treating neck injuries, it is of paramount importance to (1) relieve respiratory obstruction, (2) control hemorrhage and (3) prevent wound infection.

**Respiratory Obstruction.**—Respiratory obstruction may be due to a laceration of the trachea, allowing aspirated blood to block the respiratory tract. An opening into the trachea may also allow air to be forced into the surrounding tissues, the pressure of which may cause respiratory obstruction. Pressure from an enlarging hematoma can also cause tracheal obstruction. It is a complication occasionally observed after thyroidectomy but may result from any puncture wound in this very vascular region. The injury also may result in edema of the

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to stop bleeding and close the tracheal opening. These can best be accomplished by packing sterile bandage gauze into the wound. This same gauze packing will probably not suffice to control a hematoma developing around a severed artery but may be used as a first aid measure while bringing the patient to a hospital for definitive care.

If a respiratory obstruction does occur, an emergency tracheotomy is necessary and should be performed through a longitudinal lower mid-

in order to raise the cricoid cartilage and allow aspirated blood to gravitate away from the lungs. The advantage of having a tracheotomy tube at hand in case of such an emergency cannot be overemphasized. The handle of the scalpel, a hemostat or hooked humpins all make poor substitutes for a tracheotomy tube to hold the tracheal incision open. A 10 to 12 cm. segment of tubing from a stethoscope (if not too soft) can be slipped into the tracheal opening to maintain an airway until a tracheotomy tube is obtained or the emergency is past.

It must be borne in mind that the difficulty and hazard of doing an emergency tracheotomy in children is much greater. There are several reasons for this: the neck is shorter, more rounded, the trachea is smaller and more compressible, the great vessels are closer to the incision and the landmarks of the neck are less distinct.

**Hemorrhage**—Owing to the number and size of the superficial blood vessels in the neck, hemorrhage is rather profuse in all lacerations in this area. Control of this hemorrhage by gauze packing or pressure dressing as a first aid measure may be a life saving procedure. Closure of the individual vessels with silk or cotton ligatures or the repair of a rent in an important vessel wall is later accomplished in the operating room. Fortunately the carotid arteries and jugular veins are rarely injured. A laceration of a carotid artery usually presents no surgical problem since the patient becomes exsanguinated before the hemorrhage can become serious. The common or internal carotid of death or hemiplegia (especially of brain damage incident to

the cerebral anemia. Cases have been reported in which common carotid lacerations have been successfully sutured.<sup>1</sup> A jugular vein if

infection owing to the extreme danger in such a complication if it develops.

downward spread of a deep neck infection. The type, the virulence



given in larger doses (50 000 units intramuscularly every three hours) than in the cases where debridement was possible

Scarring in the neck as a result of lacerations is not marked, especially if they are along the lines of Langer (transverse in the neck) If the scar is unsightly, it can be excised under local anesthesia, preferably three to six months after injury, and the incision carefully approximated with small stitches of 5-0 nylon sutures

**Contusions**—Contusions of the neck are even more rare than lacerations and usually involve the trapezius muscle They are characterized by a painful swelling at the point where the blow occurred which is extremely tender Rest and ice packs are early therapeutic measures A pressure dressing applied to the contused area may aid with the ice packs in preventing further bleeding and exudation into the area In the more severe contusions of the trapezius muscle the arm on the involved side should be kept in a sling for one or two days

**Strains and Sprains**—Strains and sprains of the neck are rather common injuries in the athlete When stiffness pain or limitation of motion results from trauma it is of utmost importance to rule out by anterior posterior and lateral x rays of the cervical spine any fracture or dislocation of the vertebrae As in strains or sprains involving other parts of the body heat applied after the period of exudation has passed (six to twelve hours) will speed up the body's reparative process Local novocain injections or even mild head traction, may be necessary in the therapy of the more severe sprains

### INFECTIONS

**Furuncles**—The most common type of infection occurring in the neck is a furuncle—a *Staphylococcus aureus* infection of a hair follicle It is frequent in the neck because of the presence of many hair follicles and the irritation of collars razors barber's clippers and so on These infections frequently abort spontaneously but protection of the area from further irritation is necessary This is done by covering this stage and produces so little discomfort that it is neglected A small patch of adhesive

this early stage is an extremely easy method of preventing further irritation and probably increases local hyperemia by decreasing heat radiation<sup>3</sup> Hot moist compresses are the most effective means of therapy in the presuppurative stage When "pointing" or fluctuation occurs incision and drainage of the abscess under intracutaneous novocain anesthesia should be done at once The injection of a small amount of 2 p creates no risk the reason why not be used

wound for twelve to twenty four hours for hemostasis and a dressing

and the number of contaminating bacteria greatly influence the incidence of infection in the wound. Often the administrator of first aid introduces more bacteria than the object causing the injury. The fear of introducing bacteria must not, of course, make one hesitate to stop a hemorrhage which may otherwise prove fatal.

The time that has elapsed between injury and definitive surgical therapy influences the type of treatment. Patients with wounds, who come to operation within approximately six to ten hours of the injury (the time element varying depending upon the extent and type of contamination) should be given the following treatment. After cleansing the surrounding area with soap and water, a surgical debridement is done, washing or changing the instruments frequently. Débridement is followed by copious saline irrigations, using from a pint to several quarts of solution, depending on the size and degree of obvious contamination. If the wound is irrigated before the debridement, superficial contaminating bacteria (which are present in greater numbers at the surface of the wound) may be washed into the relatively sterile depths of the wound. Scrubbing the wound with soap and water, even though it removes the majority of the contaminating bacteria, probably makes the wound more susceptible to infection by the remaining bacteria. This is due to the fact that soap scrubbing chemically and mechanically traumatizes the tissue and in this way lowers its resistance to infection.<sup>2</sup> This effect could be overcome if the

bleeding or infection is a threat it is advisable to place a small  
 sutures We pre-  
 ep and secondary

three days

If the bacteria have had time to invade the tissues, the wound should be left open, covered with grease gauze dressing, and allowed to heal by secondary intention. In these cases penicillin should be

neck which should be diligently sought for if it is not obvious. In children upper respiratory tract infection especially pharyngitis or tonsillitis is the primary focus. Lymphadenitis located in the posterior triangle of the neck usually is secondary to an inflammatory lesion of the scalp which may be missed if a careful search is not made.

Acute cervical lymphadenitis is not a surgical problem. Nature usually aborts the inflammation before suppuration occurs, especially

remaining about the same for the period, when it might be difficult to restrain the scalpel. However these too usually subside under conservative management but when suppuration does occur immediate incision into the abscess is indicated.

**Chronic Cervical Lymphadenitis**—This is usually the result of a chronic primary focus which resists therapy such as chronic middle ear or sinus infections. These nodes do not suppurate but subside after cure of the primary focus of infection.

**Tuberculous Lymphadenitis**—This disease is becoming more and more uncommon but still is seen rather frequently in Negro children and in young adults attending our charity clinics. Tuberculous lymphadenitis a form of chronic lymphadenitis is due to the bovine strain of the tubercle bacilli probably transmitted by means of unpasteurized milk. The disease is most prevalent in malnourished underprivileged children living in unhygienic surroundings. The involved lymph nodes are usually multiple unilateral and in the early stage of the disease discrete. There is no sign of inflammation present and therefore the disease must be differentiated from the lymphoma group of diseases (Hodgkin's disease, lymphosarcoma and leukemia). The diagnosis is best and most easily accomplished by excising one of the more superficial nodes under local anesthesia for microscopic examination. If the disease progresses suppuration in one or more involved lymph nodes may occur and then a microscopic examination, culture or guinea pig inoculation of the aspirated creamy pus will establish the diagnosis. Patients should be thoroughly examined to make sure that other foci of tuberculous infection are not present. Although pulmonary tuberculosis is due to a different strain of the tubercle bacilli an x ray of the chest should be taken.

General hygienic measures such as good diet and adequate rest are important in the treatment of tuberculous lymphadenitis. X ray therapy is definitely beneficial and should be given in all cases except those treated by surgical excision of the involved nodes. Surgical treatment can be used when the lymph nodes are fluctuant to quickly remove the focus of infection in the neck, but in these cases extreme care must be exercised to avoid rupturing a tuberculous abscess and in this way contaminate the neck wound. If this happens the wound



is applied. Gauze not only does not act as a drain, but actually obstructs the purulent discharge and should not be left in longer than necessary.

Hot fomentations should be reapplied immediately after incision and drainage in severe cases. In milder cases, sulfadiazine or penicillin ointment dressings may be applied and changed one to three times a day, depending on the amount of drainage. The chemotherapeutic ointment probably has little or no chemotherapeutic effect on the infection, but may protect surrounding hair follicles from the bacteria present in the discharge and in that way prevent multiple furuncles.

infection which should be looked for, e.g., diabetes mellitus

**Carbuncles.**—Carbuncles most frequently occur on the back of the neck where the dermis is thick and tough and a furuncle ruptures into the less resistant subcutaneous tissue. This forms multiple pockets underneath the skin as it spreads across the neck, and drains inadequately through multiple openings in the skin by following the columnae adiposae. These painful and quite disabling infections some-

cision of choice is a cruciate one crossing the entire carbuncle and undermining the four quadrants completely. All the tough fascial septa should be cut, in this way opening and adequately draining all the subcutaneous pockets of pus. In a carbuncle of long standing, the fibrous septa may be so dense that undermining is impossible by means of scissor dissection, in such instances a scalpel must be used. This wound should also be packed open with iodoform gauze for hemostasis, and hot fomentations continued.

The central tips of the four quadrants of undermined skin frequently slough. This is due not only to the wide undermining of the flaps, but also to the diffuse involvement of the skin by the infection, thus interfering with its blood supply. This results in a granulating

center after the infection has cleared which may necessitate healing time. It is of the carbuncle, entire carbuncle is

**Acute Cervical Adenitis.**—Acute cervical adenitis is common, especially in children. One or more enlarged, painful lymph nodes are associated with a temperature of 105° F in children. This is an infectious disease, but is usually secondary to an infection in the head or

cal of this disease are more numerous in the pus from a ruptured abscess than in the discharge from a sinus

Since the actinomyces are anaerobic surgical incision into the infected area with excision of necrotic tissue (which may include part of the mandible secondarily invaded) is advised Sulfonamide therapy especially sulfadiazine has proved efficacious as has to a lesser extent x ray therapy zinc peroxide and 10 per cent thymol solution Penicillin in large doses (1 000 000 to 5 000 000 units per day) is the most effective agent and should be combined with sulfadiazine

### TUMORS

Tumors of the neck are common and their excision constitutes most of the minor surgical procedures involving the neck There are a great variety of tumors found in this area and the removal of some of those to be discussed cannot strictly be classified as minor surgery Certain others are discussed elsewhere in this issue and will only be mentioned here

**Pigmented Nevi**—Pigmented nevi or common moles occur on the neck as they do elsewhere over the body If they are situated in a position where they are frequently irritated they should be excised Electrocautery of small moles is a safe procedure if done adequately but excessive scarring and the impossibility of an accurate microscopic examination makes this treatment inferior to an elliptical excision This excision should include 1 to 2 mm of normal skin on either side of the nevus and be placed along the lines of Langer so that careful approximation will result in a fine line of scar which is usually unnoticeable after the scar contraction has obliterated its vascularity

**Lipomas**—Lipomas of the anterior neck are readily removed but in the posterior neck owing to the tough fibrous strands there the operation may be a rather bloody and difficult minor surgical procedure These same fibrous strands also make the lipoma feel more firm and diffuse than it does elsewhere and frequently the correct diagnosis is not made until it is removed

Hemangiomas sebaceous cysts keratoses and basal cell and epidermoid carcinomas are discussed in detail elsewhere in this volume

**Thyroglossal Duct Cysts and Fistulas**—As the thyroid develops from an outpouching of the primitive foregut the upper end of the pyramidal lobe of the thyroid is connected to the foramen cecum of the tongue by a stalk When the obliteration of this stalk does not occur a midline cystic mass may develop It is usually lined by squamous epithelium derived from the oral cavity and produces few symptoms except the tumor mass which characteristically rises in the neck on swallowing If a secondary infection occurs signs of a localized abscess develop Fistulas are usually the result of incision and drainage of a thyroglossal duct cyst

as well as the surrounding skin, may become infected and resist healing for many months despite x ray treatment. Many surgeons aspirate the tuberculous abscess in conjunction with x ray therapy with good results. Incision and drainage should be avoided because a chronic draining sinus results.

**Ludwig's Angina**—This is a deep infection of the floor of the mouth usually caused by the streptococcus although other bacteria are frequently noted on culture. Ludwig's angina usually has its onset after extraction of an infected tooth, but any open lesion of the floor of the mouth may result in this type of infection. The brawny, painless swelling of the floor of the mouth and lower jawbone and chin, with tenderness of the floor of the mouth and tongue, and forward and backward and often protrudes from the mouth as a result of the marked swelling. Dysphagia is always present and if glottis or larynx is involved, respiration is impaired. Very rarely the infection may spread to the mediastinum. The infection subsides. Bed rest, intravenous fluids and penicillin therapy are important supplements to the surgical treatment.

**Lateral Pharyngeal Space Infection**—The lateral pharyngeal space infection arising from a primary focus, usually from the tonsillar bed, is probably the most common of the deep infections of the head and neck. The infection may spread to the retropharyngeal space from the great vessels may occur not because of pressure necrosis of the vessel walls, but rather as a result of inflammatory destruction of the vessel walls. The abscess which produces the swelling of the mandible and the sternocleidomastoid muscle, at intracranial or mediastinal level. The drainage of this space is through an incision anterior to the sternocleidomastoid muscle. After the skin and the muscle are incised under local anesthesia, dissection of the abscess is carried out by means of the finger.

**Actinomycosis**—Actinomycosis is an infection caused by the ray fungus which probably involves the neck more often than any other part of the body with the possible exception of the abdomen. The infection for the organism is an opening in the oral mucosa,

through multiple sinus openings.

terial which varies from clear to purulent in character. Most of these are caused by the surgeon's scalpel incising rather than excising the cyst. Incision into the cyst may, however, be necessary if a severe or persistent infection is present.

Complete lateral cervical fistulas are rare but, when they do occur, they travel a constant course through the neck according to McNealy.<sup>1</sup> The internal opening is usually in the tonsillar fossa and the fistula courses under the angle of the mandible down and out under the midportion of the posterior belly of the digastric muscle, below the facial nerve and over the glossopharyngeal nerve to come in contact with the great vessels of the neck and out the cutaneous opening anterior to the sternocleidomastoid muscle.

The surgical removal of a complete lateral cervical fistula is not minor surgery. The removal of a branchial cyst, however, may be readily accomplished under local anesthesia through a transverse incision over the tumor. It is exposed by cutting the cervical fascia anterior to the sternocleidomastoid muscle and retracting the muscle posteriorly. Previous inflammation in the cyst may make the removal more difficult even though the thicker, more fibrotic cyst wall may withstand more surgical trauma. Rupture of the cyst wall always makes complete removal more difficult and less certain.

**Mixed Tumors**—Mixed tumors arising in the lower portion or cervical process of the parotid gland are sometimes located in the upper neck and may be mistaken for pathological lymph nodes. Removal of small mixed tumors of the parotid in this region may be done on the ambulatory patient but incomplete removal (especially if repeated two or three times) may result in a major surgical transformation of the pathologic process. We have all seen malignant parotid tumors arising from incompletely excised benign mixed tumors. There are several reasons for the high frequency of recurrence in this particular type of tumor: (1) the fear of inflicting a permanent facial palsy on the patient by injuring the facial nerve which courses and branches between the superficial and deep lobes of the parotid gland; (2) attempt to remove an iceberg type of mixed tumor of the parotid through a small opening in the parotid fascia; (3) undue surgical trauma; and (4) the lack of recognition of the delicate nature of the tumor capsule which must be removed completely. Mixed tumors may also occur in the other salivary glands but with much less frequency.

Cysts and cystadenomas occur in the salivary glands but are extremely rare. The former, usually congenital, is lined by a single layer of duct epithelium and responds to simple excision. Cystadenomas have great potentialities for becoming malignant, and if they occur in the submaxillary gland the entire gland should be sacrificed. This can readily be done under local anesthesia through an incision over the tumor mass paralleling the mandible.

Although cures have been reported by the use of sclerosing solutions injected into the cyst or fistula the only recommended treatment is their complete excision. This may be carried out under either local or general anesthesia and should be done through a transverse incision. If a fistulous opening in the skin is present an elliptical incision is made around the opening. If the tumor lies low in the neck a second transverse incision (higher) is recommended in order to facilitate the dissection of the tract through the center of the hyoid bone into the substance of the tongue. A segment of the hyoid bone

not recovered recurrence usually results

**Other Benign Midline Tumors**—These are usually of thyroid origin also. Undescended but otherwise normal thyroid tissue may be located at any point between the foramen cecum of the tongue and the normal location of the thyroid gland. If normal appearing undescended thyroid tissue is found on exploration of a midline tumor a biopsy should be taken and the thyroid area explored to ascertain whether or not sufficient thyroid tissue is present there to prevent myxedema if the ectopic thyroid is removed.

Enlarged pyramidal lobe of the thyroid, adenoma of the pyramidal lobe and adenoma of the thyroid isthmus may present themselves as midline benign tumors. Discussion of these is not within the scope of this paper.

Lateral neck tumor masses present a more complicated problem of preoperative diagnosis than the midline tumors.

**Lateral Cervical Cysts**—Lateral cervical cysts, or branchial cleft cysts, originate embryologically from the ectodermal grooves formed during the first month of intrauterine life. A Russian surgeon, Wenigowski,\* after many years of careful study came to the conclusion that many of these lateral cysts had their origin in unobliterated thymic ducts which arise from the third branchial pouch.

These tumors also usually produce no symptoms, being evident only from the presence of the tumor mass unless secondary infection occurs. Infrequently the size alone may produce by pressure symptoms such as coughing, dysphagia, dyspnea or hoarseness.

Lateral cervical cysts may occur anywhere along the anterior border of the sternocleidomastoid muscle. They are smooth, discrete, nontender and cystic in character. Aspiration of some of the fluid by means of a syringe and needle will aid greatly in establishing the

the high up to

Occasionally just a sinus opening will be present discharging a

or larynx if it is not obvious on the lip or in the skin about the face. Frequently one must be a true medical detective to discover the primary carcinoma.

Occasionally though it is very rare, the primary tumor may have originated in a small branchial cleft cyst and, therefore, the primary tumor may appear as one of the metastatic nodes.

After the primary lesion has been eradicated, the metastases should be removed by a radical neck dissection, which is far from minor surgery. Although surgical removal is preferable, neck nodes can be sterilized of tumor cells by *adequate interstitial irradiation*. The insertion of radon seeds can readily be done under local anesthesia without hospitalization of the patient whose primary tumor cannot be cured, or whose general condition would not tolerate a radical neck dissection. Occasionally a rapidly enlarging node, or a node which may shortly become fixed to the mandible, may, in the same way, be controlled until the primary lesion is cured and the malignant cells enroute through the lymphatic channels are stopped by the lymph nodes and a radical neck dissection then done.

**Lymphosarcoma, Hodgkin's Disease, and Leukemia.**—Lymphadenopathy, usually cervical, is one of the early symptoms of these diseases. These nodes have not the hardness of metastatic carcinoma, but are firm discrete and noninflammatory. The only minor surgical aspect of these diseases is the removal of such a node for microscopic

ing a transverse cervical incision through the skin and bluntly spreading the subcutaneous tissues with a curved forceps, exposing the pathological lymph node. Grasping a fibrous tag on the surface of the node will facilitate its removal.

One must not forget the danger of bleeding, even from such an insignificant surgical procedure, especially in a leukemic patient with marked depression of blood platelets. Careful hemostasis should be accomplished by ligation of bleeding points and closure with vertical mattress sutures going deep into the wound.

#### COMMENT

Although in the foregoing pages I have occasionally digressed from the realm of minor surgery in the strict sense of the term, most of the pathologic conditions mentioned may be safely treated by simple surgery. There are many dangers, however, such as severe hemorrhage, respiratory obstruction, air emboli, and *novocaine sensitivity*, which should make one hesitate to perform any but the most minor of such surgical procedures where access to oxygen, a more major surgical set up, and surgical assistance are not readily available.

Swellings of the submaxillary gland often are not tumors but are caused by retention of submaxillary secretion as a result of obstruction of the patient is

sufficient to cause pain in the gland. Palpation of a stone in the submaxillary duct through the floor of the mouth, noting a grating sensation on probing the duct, or visualization of the calcium carbonate stone on x ray will establish the diagnosis. Sialograms may also be

the mouth

stones are

multiple and in the gland itself. In these cases surgical excision of the gland becomes necessary.

**Cystic Hygroma.**—Cystic hygroma is a congenital lymphangomatous type of tumor found in the neck, usually in children. This soft, cystic, compressible tumor is lobulated with a fairly distinct border. Although it is softer and does not refill as rapidly after compression as lymph by means of a needle. The size of the tumor varies with the age of the patient. Whether the surgical excision is a relatively minor procedure or an extremely major operation.

Occasionally these cystic hygromas extend from the floor of the mouth into the mediastinum.

of sclerosing solution into the cystic tumor after aspiration may control the growth until the patient is old enough to better tolerate excision. Rarely does this form of therapy make surgical removal unnecessary in the future.

**Carotid Body Tumor.**—This is another solitary lateral neck tumor, usually found in the lower part of the neck of the carotid sheath.

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discussed, are important in the differential diagnosis of multiple

carcinoma should always be considered when nodes are discovered in the neck. It should be made to find the primary site of origin. In the preclavicular region, carcinoma of the stomach, esophagus or breast should be looked for.

Submental, submaxillary, superficial or deep cervical metastases usually have an epidermoid carcinoma primary in the mouth or pharynx.

## SUPERFICIAL TUMORS OF THE HEAD AND NECK AREA

DANIEL P. SLAUGHTER, M.D.\*

THE surgical treatment of superficial tumors of the head and neck area can be considered "minor surgery" from the standpoint of extent of surgical maneuver involved. From the standpoint of consequences

gery. The most serious result, however, is recurrence from inadequate excision of a malignant tumor. Too often the concern over a poor cosmetic result will allow a surgeon to skimp on the amount of tissue excised when removing a malignant tumor, with the almost inevitable consequence of recurrence. Such a patient is usually then referred to a "cancer specialist" who must either perform a harrowing and destructive excision, or compromise with his conscience, and the patient's life, and use palliative radiation. Fortunately most skin tumors of the head and neck area do not have such serious implications, yet the problem is ever present and may require expert judgment in separation of the sheep from the goats.

### COMMON BENIGN TUMORS OF THE SCALP, FACIAL AND NECK REGIONS

**Sebaceous Cysts.**—Sebaceous cysts are common lesions of the skin of the head and neck area, being most frequent in the scalp and in the upper neck behind the ears. In the scalp they are popularly referred to as "wens." A sebaceous cyst results from obstruction of the duct of a sebaceous gland, with consequent retention of secretory products. They are easily diagnosed. They are oval, or rounded and globular subcutaneous masses with a smooth contour and of a rubbery and a

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**Sebaceous Cysts.**—Sebaceous cysts are common lesions of the skin of the head and neck area, being most frequent in the scalp and in the upper neck behind the ears. In the scalp they are popularly referred to as "wens." A sebaceous cyst results from obstruction of the duct of a sebaceous gland, with consequent retention of secretory products. The gland dilates and the lining epithelium becomes cornified and differentiates to a stratified squamous variety, like the skin.

saclike lining membrane until a globular subcutaneous mass is present. This may be from 0.5 to 5 or 6 cm. in diameter, but averages 1 to 2 cm. Clinically there are several distinguishing features which make sebaceous cysts easily diagnosable. They are oval or rounded and globular subcutaneous masses with a smooth contour and of a rub-

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Fig 18—A, Typical mixed capillary and cavernous hemangioma of the lower eyelid. This was obliterated by multiple treatments of CO<sub>2</sub> snow and sodium morrhuate injections. B, Patient with multiple precancerous keratoses and four separate epidermoid carcinomas, all of which were treated by radiation and patient has been free of evidence of disease for four years. This illustrates the back

bery or doughy consistency They are *always* attached to the skin, of necessity because of their central opening through the skin There is always this central "pore" which may be obvious, but may require a magnifying glass to see

Indications for treatment are in four categories the annoyance to the patient of the lump, the cosmetic defect on the face or bald head, the problem of recurring suppuration, and the patient's and doctor's curiosity

The treatment is total excision, usually a very simple procedure, there being only two fundamental rules required The cyst should not be removed during a phase of acute bacterial inflammation The cyst wall must be removed entirely, including its central opening The customary incision is elliptical and placed over the center of the long axis of the cyst The incision should include the central opening of the cyst in the oval of skin outlined by the incision Such an incision accomplishes three purposes it insures removal of the central opening, it facilitates dissection of the cyst by allowing approach where the cyst is not in proximity or continuity with the skin, and it obviates redundancy of skin in wound closure Sebaceous cysts are usually removed under local anesthesia Careful infiltration of procaine intracutaneously will make dissection easier for the surgeon and more comfortable for the patient

Very rarely an epidermoid carcinoma arises from a sebaceous cyst. This is so rare as to be almost a curiosity and such an occurrence is not an important consideration

**Warts.**—The common wart or verruca vulgaris, is much more frequent on the hands than the skin of the head and neck area These virus "warts" when they do occur about the face may be removed by any one of several destructive methods, excision, X or gamma radiation, acid etching or just waiting it out, but the two simplest methods are electrodesiccation or freezing with carbon dioxide ice

**Lipoma**—Lipomas are relatively uncommon tumors about the head and neck area, their incidence in this region being perhaps most fre

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ground of senile and atrophic skin from which such lesions commonly arise C, Recurrent basal cell carcinoma in a characteristic location This is a dangerous area because of proximity to eye and blindness if treatment is inadequate or inaccurate D Lesion of left cheek which clinically looked like a basal cell carcinoma but which on biopsy proved to be blastomycosis This illustrates the importance and necessity of biopsy in diagnosis of such lesions E Typical epidermoid carcinoma of ear Indication for treatment in this location is surgery rather than radiation because of the proximity of the underlying cartilage and the almost invariable chondronecrosis that results from radiation F Young woman who had mole removed from behind left ear without section Illustration shows metastatic melanoma in upper neck node the pigment of which can be seen shining through the skin This patient was dead in three months from generalized metastases Such a situation illustrates the absolute necessity of microscopic definition of all tumors removed and consideration of metastatic disease to the neck.

quent in the neck and forehead. The trunk and extremities are more usual sites for this tumor. A lipoma is a benign, encapsulated neoplasm composed essentially of adult fat cells with a varying proportion of fibrous tissue stroma. The consistency of the tumor to palpation depends largely on the fibrous tissue component, since in this area most lipomas are located external to the deep fascia. Those composed principally of fat will be soft, lobulated, almost fluctuant swellings whose margins are indistinct but whose diagnosis is usually obvious. The lipomas which contain more fibrous tissue will appear as more discrete and firm lesions and may be confused with sebaceous cysts, peripheral nerve lesions such as neurofibromas, or hemangiomas. In contrast to the latter, lipomas occur mainly during the adult years.

The only treatment is surgical and the indications for removal are

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These are not uncommon lesions in the head and neck area in infants and are frequently multiple. There are two fundamental types of hemangioma, the cavernous and the capillary, the former being a tumor composed of large dilated sinusoids lined by a single layer of apparently normal endothelium. The capillary type, as its name implies, is composed of a profusion of enlarged capillary-like vessels, again lined with a single layer of endothelium. The usual hemangioma as seen clinically comprises a mixture of both elements in varying

of the hemangioma, and the soft, bluish, compressible part of the tumor is the underlying cavernous portion.

Pure cavernous hemangiomas appear as soft, rounded, subcutaneous tumors. They usually have dilated sinusoids and the tumor itself may pulsate. The latter type can be confused with a neurofibroma as a more discrete lesion.

Occasionally the cavernous hemangiomas pulsate, due to incorporation of a large "feeder" artery.

The pure capillary hemangiomas are flat intracutaneous lesions, bright or dusky red in color, and unfortunately may be quite extensive in surface area. This type of lesion is the familiar "port-wine stain," or "nevus flammeus." From the microscopic point of view these are the most innocuous lesions as to degree of tissue change and prognosis, yet the personality repercussions of such a lesion may literally and figuratively color the whole life of the individual.

Hemangiomas are vascular anomalies rather than true neoplasms, their eventual size is predetermined, may "grow" rapidly for a time, their area of tissue occupation is limited, and afterwards they enlarge

Malignant transformation, metastasis and death are so rare in relation to hemangiomas that they are pathological curiosities.

All of the above considerations have direct bearing on the choice of treatment of hemangiomas. Obliteration of these lesions may be accomplished by surgical removal, or by treatment directed toward fibrosis and thrombosis by irritation and endothelial injury. Treatment methods in the latter category are the more usual, and consist of X, gamma, or beta radiation, injections of irritating substances, or freeze

infiltration of these lesions beyond their apparent limits, because of the possibility of

superseded surgery. Today, however, this trend is being reversed, as better understanding of the limitations of each form of therapy is becoming evident.

The philosophy of treating a hemangioma should be the use of the least destructive agent that will obliterate the lesion. The crimes against normal tissue that have been committed by injudicious irradiation have created a trend away from this very effective means of treatment. Excessive or inaccurate irradiation may produce irreparable damage to highly specialized tissue such as the cornea or lens, or it may destroy the growth capacity of immature tissues. In addition, the progressive late changes in irradiated tissue may create serious problems years later, even to the extent of radiation cancer occurring in preadolescent children who were treated for hemangiomas in infancy. Radiation treatment of these lesions should be reserved for experts with wide experience. Choice of modalities, either x-ray,

and capillary hemangiomas, as seen in infants, is the use of sclerosing agents injected within the cavernous portion and carbon dioxide freezing of the external pigmented capillary portion. Sodium morrhuate, sylnasol or similar sclerosing agents commonly used for injecting

varicose veins are the drugs usually employed. The dose is from 0.25 to 5 cc depending on volume of tumor to be injected. The drug is distributed through the area without any attempt at intraluminal injection. The tissue reaction desired is one of contracting fibrous thrombosis being helpful but incidental. The carbon dioxide snow treatment affects the lesion only to a depth of a millimeter or so and is applicable only to the superficial capillary portions. Multiple treatments may be necessary and desirable as overtreatment with any of the methods used for hemangiomas will create irreversible tissue changes which are not only undesirable but unnecessary.

**Moles**—The lesion commonly referred to as a "mole" is actually a "neuronevus" a specific lesion composed of nests of polyhedral cells which are part of the pigment producing mechanism of the body. These melanoblasts produce the brown pigment melanin which is the normal pigmentation of the skin and adjacent mucous membranes. The melanophores or pigment producing cells are derived probably from ectoderm of the neural crest of the embryo and apparently migrate to the periphery along with the peripheral nerves. Control of their function seems to be through several processes. The cells react to physical stimulants such as ultraviolet light and produce melanin. Thus is the familiar process of tanning after "sunburn." There is also an endocrine factor of control as evidenced by increased pigmentation at puberty and during pregnancy.

The anomalous aggregates of these melanophores into small subcutaneous "tumors" are the common "mole" and may be more or less pigmented. The number of nonpigmented moles is much greater than is generally appreciated. The ordinary brown mole is undoubtedly the most common benign "tumor" affecting humans. Almost everyone has one or more somewhere on the body. They are not true tumors in the neoplastic sense but like hemangiomas are really congenital anomalies. They are most common about the head and neck area and

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a melanoma the mole in the point of view is obvious  
at random become  
point. It is fairly

well established however a mole carries  
a certain danger and it is probably well to remove these lesions  
when they are located in an area exposed to irritation. In the head

and neck area, these would be nevus situated where a shoulder strap

the gravest concern when it does occur. The malignant melanoma is one of the most vicious tumors in the human body, with one of the lowest cure rates.

There is no way absolutely to diagnose a mole that has become malignant except by microscopic definition. Experts with wide experience have a good percentage of clinical accuracy, but it is not perfect. Diagnostic error possibly occurs mainly with the nonpigmented malignant melanomas, which are more frequent than is usually realized. These are not infrequently mistaken for basal cell or epidermoid carcinoma and treated by radiation without biopsy. Much has been written about the factors in differentiating a benign from a malignant "mole," and there are popular misconceptions about the "hairiness" or "blackness" of these lesions. The accurate information mainly boils down to two factors: any change in a mole is a danger signal, the sudden appearance of a "mole" in an adult, where none existed previously, demands investigation. Changes that may occur are increase in size, or increase in depth of pigmentation, serous or bloody discharge, or actual ulceration. A particularly significant change is the appearance of a corona of brown or bluish gray color as an irregular margin about the raised portion of a mole.

**Removal of Moles**—There is considerable mythology and misunderstanding about the treatment of moles. There is much popular fear that disturbing a mole in any way may be dangerous. In my personal experience and in the literature there is no authenticated instance

malignant in the first place and usually treatment was instituted because of the changes incident to unrecognized malignant transformation. Dermatologists have removed thousands and thousands of moles with acid, carbon dioxide snow, electrocautery and so forth, without untoward occurrence. Removal of moles on the face for cosmetic reasons by these methods would seem to be perfectly safe. There are two disadvantages to such procedures: (1) no tissue is removed for microscopic section, and (2) the destruction of the lesion is almost always incomplete. This is because total removal would leave an unsightly scar, and usually a compromise is made with cosmetic considerations.

The safest procedure is total removal of the mole by careful excision. A nevus is a finite lesion and if it is totally removed it cannot metastasize from a bottle in the pathology laboratory. If a



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tween pigmented seborrheic keratoses and nevi.

"moles" is three fold when large pigmented cond. problem is the

ously much lower. The chance of any mole becoming a melanoma is reduced almost to the vanishing point. It is fairly well established, however, that continued irritation of a mole carries a certain danger and it is probably well to remove these lesions when they are located in an area exposed to irritation. In the head

*cancerous lesion* These occur usually about the anterior and central portions of the skin of the face about the nose cheeks and forehead and also on the upper portions of the ears (Fig 18 B) They are seen principally in patients with thin atrophic and senile skin and frequently but not always such patients have had excessive exposure to sun and wind The senile keratosis is a flat poorly delimited lesion which tends to be multiple or diffuse in the sense of coalescence of multiple separate foci The lesions frequently have a reddened inflammatory base and the surface is a thickened scaly gray which is granular or gritty to the touch At the onset such keratoses are frequently a reversible epithelial change and they may be made to disappear after application of petrolatum or lanolin They recur in the same place repeatedly and finally will persist When they become heaped up and especially if they ulcerate or form crusts the base will usually show early epidermoid carcinoma which if early enough may be intraepithelial and pre invasive If allowed to persist a typical ulcerating squamous cell carcinoma will result

Treatment of senile or precancerous keratoses depends on the stage of evolution of the lesion Early changes may be held in check for some time by the use of emollients and good skin care The persistent lesion is a radiation problem essentially although small areas may be destroyed by application of carbon dioxide snow Low voltage unfiltered x radiation is the usual treatment although beta radiation is equally or more effective and creates far less radiation change in depth in normal tissue The lesions can be excised but usually the epithelial change is so superficial that this hardly seems necessary especially since the lesions are usually multiple and diffuse to an extent that makes surgery impractical

One word of warning is apropos Many innocent appearing keratoses of this type will have epidermoid carcinoma in their base The destructive treatments used may destroy adequately the cancerous area but one must always be on guard If there is the slightest doubt biopsy should always be done

*Epithelial Horns*—The epithelial horn is an uncommon and usually isolated lesion which consists of a conical tumor mass raised as high as 1 to 1.5 cm above the skin surface and composed of a tough keratinized epithelium The protruding lesion is frequently broken off and may be repeatedly picked off by the patient leaving an ulcerated base which rapidly reforms the lesion The base is so often composed of a low grade highly differentiated squamous cell carcinoma that all such lesions should be considered to be cancer and should be treated as such Either adequate surgical removal or adequate radiation should be used

*Leukoplakia*—Leukoplakia of mucous membranes is the analogue of keratosis of the skin Keratinized squamous cell excrescences of mucous membranes appear white when continually moist and macer

mole is being removed for cosmetic reasons, the larger the lesion, the greater the indication for excision, using careful plastic surgery technique and repair. A fine "hair line" scar is far better than the scar of cautery destruction. If a mole is being removed for prophylactic purposes or for diagnosis in case of doubt, then excision is mandatory. An oval incision about the mole, a millimeter or so from its edge and cutting well under it, is perfectly adequate removal. If ligatures are necessary, a 4 or 5-0 catgut should be used, and the skin should be

prophylactic removal of moles, it is worth noting that malignant melanoma, for all practical purposes, does not occur before puberty, and therefore removal of suspicious or vulnerable nevi in childhood is entirely safe.

When there is question of malignant change in a nevus, conservative excision as in prophylactic removal is indicated. The treatment of malignant melanoma is surgical, and does not come under the heading of minor surgery. The radical surgery required should not be performed on a patient unless the diagnosis is clinically obvious or confirmed microscopically after conservative excision of the lesion. The trap to avoid is semiradical surgery for suspicious lesions. If the lesion is benign, unnecessary damage has been done. If the lesion is malignant, the tendency is to rest on what has been done in the hope that it is enough, an unjustifiable compromise of the patient's life.

Finally there are two important points about nevi that should be emphasized. Radiation has no place in the treatment of benign moles, nor in the treatment of operable and potentially curable malignant melanoma. The cells composing these tumors are radioresistant to the point of reversal of the rationale of radiation therapy. The second

and neck of importance, both occurring in older individuals. The pigmented *seborrheic keratosis* is usually multiple and ordinarily is found first in the skin of the upper and lateral portions of the face and forehead. These lesions are soft, brownish, slightly raised oval areas, usually measuring 1 to 2 cm. in length, with a velvety feel to light touch. They may be confused with pigmented moles or carcinoma by the casual observer, but their clinical diagnosis is easy. They are harmless lesions and are not considered to be precancerous. A few patients tend to have them in profusion and they become a cosmetic problem. Removal is usually simple by electrocautery with local anesthesia, carbon dioxide snow, or excision.

The *senile keratosis* is of more concern, as it is distinctly a pre

**Basal Cell Carcinoma.**—Basal cell carcinoma is the most common form of malignant skin tumor. The term is applied loosely to several lesions of similar characteristics arising from various related skin appendages. They all have two habits in common. Most are very slow-growing, sluggish tumors, and most of them do not metastasize. These two characteristics have lulled most of the profession into regarding basal cell carcinomas with some contempt, as being relatively harmless lesions. This is true in the early stages, but an uncontrolled basal cell carcinoma over a period of years can cause extensive and irreparable tissue destruction. Occasionally one is found with an expectedly rapid growth potential.

The typical basal cell carcinoma or "rodent ulcer" appears as an irregularly rounded or oval plaque in the skin with a central depressed area and raised borders (Fig. 18, C, D). The central area may or may not be ulcerated, but in those lesions over 1 cm. in diameter it usually is. The raised edge of the lesion exhibits the classical "pearly border" appearance, due to the rose gray, translucent quality of the tumor tissue. The earliest and smallest lesions of this type consist of a solid mass of this translucent tumor tissue. As the lesion enlarges by peripheral and internal extension, some degree of central atrophy occurs, thus creating the usual picture of raised borders. The basal cell carcinoma seems clinically to be a well defined lesion whose limits are easily discerned. Unfortunately, this is never true, as the lesion always has extensions which are only microscopically apparent. This pitfall, the seemingly limited extent of the lesion, is one of the reasons for recurrence following treatment.

The most common methods of treating basal cell lesions are by

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ment of the usual small basal cell carcinoma. The method, however, is occasionally the only recourse in the far advanced tumors which are persistent after many bouts of radiation and surgery, a situation to which "tumor clinics" commonly fall heir.

For the majority of basal cell cancers the usual treatment is either surgery or irradiation. Excision of the lesions will obliterate any of these tumors that radiation methods will control and many that cannot be so controlled. There is, however, one drawback to surgical treatment. Most basal cell tumors are on the face, frequently in complicated areas such as the eyelids or nose, locations in which cosmetic effect is of great importance. The fear of scarring, contraction, ectropion or other deformity too often leads to excision of an inadequate block

ated On the vermilion border of the lip this type of epithelial change occurs almost exclusively on the lower lip in males When barely discernible as a diffuse filmy leukoplakia which is not palpable, it is probably of no consequence and treatment should be directed towards protection of the area from further irritation This means avoidance of sunburn changing smoking habits, even if only to the extent of using a cigarette holder and use of emollient ointments Leukoplakia of the lip which is palpable should be excised if it persists after conservative care "Chapped" lips will respond to treatment, but the leukoplakia that persists as a crusting plaque in one area of

membrane of almost the entire lower lip must be excised in this manner I have had several instances in which such a specimen showed intraepithelial carcinoma in several areas on serial section When an excision of this type is done carefully, and very fine suture and ligature material is used, the resultant scar is practically invisible and there is no loss of substance of the lip

Carcinoma of the lip is always epidermoid carcinoma of the vermilion border and is almost confined to the lower lip in males The early small lesions should be obvious and treatment may be either by surgery or irradiation The classic V excision is the usual procedure and may be done under local anesthesia If an adequate margin is removed, the cure rate is excellent Radiation therapy of the small and superficial lip cancers is equally effective if given in adequate dosage The large fungating lip cancers that require an extensive removal of tissue and more or less complicated plastic reconstruction should not be treated by irradiation They are surgical problems entirely and do not come under the heading of minor surgery In these very extensive lesions it is tempting to use radiation but this is a serious error

All lip cancers are capable of metastasis so that obliteration of the  
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#### BASAL CELL AND EPIDERMOID CARCINOMAS OF THE SKIN

The term "epithelioma" is a professional colloquialism which is used to refer to basal cell and epidermoid cancers of the skin The use is not entirely correct as warts and keratoses could be included in the strict meaning of the term Combining both forms of skin cancer under one heading may lead to careless thinking as the harmful potentials of the two types are quite different

part of the physician who undertakes it the most exact estimate of the lesion obtainable should be the basis of treatment. For this reason every lesion treated as cancer by radiation should be checked microscopically by biopsy. Every lesion removed surgically should be sectioned and a pathological diagnosis obtained. In any case of doubt when diagnosis is equivocal or course of treatment is questionable biopsy should be performed.

The removal of a piece of tissue for biopsy purposes is a simple procedure when superficial tumors of the head and neck area are concerned. In the larger skin lesions particularly those which are ulcerated and have polypoid tendencies no anesthesia is necessary. Solid tumor tissue does not contain nerves and a small piece of pure tumor tissue may be removed by scalpel, scissors or biopsy forceps from the center of a tumor without pain. When the tumor is small and some normal tissue must of necessity be removed a few drops of procaine injected about the edge and under the lesion will suffice. Usually a bistoury blade will be best in this situation removal of a small wedge of tissue being easy with the triangular blade.

The importance of biopsy diagnosis cannot be overemphasized. This is not only true of the general tumor field in which performance of a biopsy may be more or less complicated. In superficial tumors of the head and neck area where removal of a fragment of tissue is such a simple procedure no lesion should be treated by irradiation without biopsy and none should be treated surgically without microscopic assay of the excised tissue (see Fig. 18 F). In addition to accuracy and control in the practice of medicine medicolegal considerations alone demand biopsy diagnosis.

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of tissue. The lack of facilities or capabilities for plastic repair may equally deter the surgeon, with the too common result of recurrence of the tumor. These factors, plus the popular misconception that surgery is more painful, more complicated and more difficult than irradiation, have put surgical treatment of basal cell skin cancer in a role secondary to irradiation.

Whether a skin tumor is obliterated by excision or by irradiation, the same block of tissue must be removed or treated. In the majority of instances x ray therapy is the treatment of choice for most basal cell carcinomas.<sup>3</sup> This should be done by an expert, and it must be done accurately and adequately. The cure rates of surgery and irradiation are comparable if both methods are used correctly. It must be realized that a combination of the two methods is only rarely of benefit. To expect inadequate radiation to make up for inadequate surgery is to assure recurrence. If adequate radiation is used postoperatively, there would be no need for the surgery in the first place. In other words, the common practice of excising a skin tumor and then asking the radiologist to give a little postoperative radiation is nonsense. The two modalities do not complement each other, and the rare instance where combination is justified requires expert judgment.

**Epidermoid Carcinoma.**—The epidermoid or squamous cell carcinomas of the head and neck area are more serious tumors than the basal cell, both in the rapidity of their growth, and in the fact that

and of slow growth but they all should be given more immediate attention than is necessary with basal cell carcinoma.

The treatment of epidermoid carcinoma of the skin is similar to that of basal cell carcinoma. Irradiation and surgery are the two methods most commonly employed. Treatment methods in either category do not differ from the techniques required for basal cell cancers of comparable extent. A more critical attitude is necessary, however, for the consequences of failure are more disastrous when epidermoid carcinoma recurs. The essential difference in the treatment of basal and squamous cell skin cancers is cognizance of the metastasizing potential of the latter tumor. This means more frequent and more rigid follow up. Patients with basal cell carcinoma do not die from

doubtful instances, and in spite of the vagaries of pathologic diagnosis it is far more accurate than clinical impression. Since the treatment of a malignant lesion entails considerable responsibility on the

part of the physician who undertakes it the most exact estimate of the lesion obtainable should be the basis of treatment. For this reason every lesion treated as cancer by radiation should be checked microscopically by biopsy. Every lesion removed surgically should be sectioned and a pathological diagnosis obtained. In any case of doubt when diagnosis is equivocal or course of treatment is questionable biopsy should be performed.

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## MINOR SURGERY OF NOSE AND THROAT

FRANCIS L. LEDERER, M.D., F.A.C.S.\* AND M. H. CUTLER, M.D.†

THE classification of surgical interventions as minor or major in nasal and pharyngeal diseases is more or less of a controversial question. There are some procedures which are definitely of a minor character while others are considered major by some and minor by others. For example, tonsillectomy falls into this latter category. If we were to

one its implications are such as to call for caution and care not only during the operation itself, but more important, after the operation has been performed. It is of major consideration for one to possess

cedure

### NASAL MINOR SURGERY

**Epistaxis (Nasal Hemorrhage).**—The average nosebleed is of little or no significance. Bleeding usually stops spontaneously or is easily controlled by anterior packing with a vasoconstrictor. It is in the cases of persistent and recurrent epistaxis that more drastic pro-

missed. They are somewhat analogous to abrasions of the corneal epithelium which may readily be overlooked unless stained and inspected carefully.

not be altogether nasal in origin. Alveolar (gum margin) sites for bleeding may be detected in such cases by the patient making a sucking action.

Of the local measures which are used in controlling superficial or dermal seem most effective (1)  
(3) trichloroacetic acid and  
like other forms of cauteriza-

tion requires preliminary analgesia.

The technic for the use of the *electrocautery* follows.

A tampon is shaped and tapered to fit within the nasal cavity. By means of a bayonet forceps the tampon is dipped either in solution containing 2 per cent pontocaine or 4 per cent cocaine and a few drops of epinephrine 1:1000 solution is added. The excess material is shaken or wrung off from the pack. This is introduced gently into the anterior nose through a nasal speculum and with adequate illumination taking care to avoid abrasion with metallic forceps. It is well to keep all the packs in place for at least five to ten minutes. A well guarded electrode which has previously been tested for its effect and strength of current is placed against the bleeding point and current is applied. The electrode is then quickly removed without touching the surrounding normal structures.

While cauterization as described is usually all that is required if the bleeding originates from an anterior source as in Kiesselbach's area the results are not so favorable if the bleeding point is situated over a larger area anteriorly or posteriorly. A more thorough electrocautery procedure as follows may help.

After local anesthesia has been effected a small dome-shaped piece of gauze is cut out and white petrolatum is applied to either side. The gauze mesh is placed against the bleeding site and the cautery is used directly over the mesh. A resulting eschar forms over the entire area and the result is a coagulum which if allowed to remain in place for either twenty-four to forty-eight hours will act in preventing further bleeding and give a scaffolding effect for new vascularization and healing.

The patient is instructed that occasionally the above may not be completely effective and if bleeding should recur he should, in sitting position with head forward, apply cotton with small amount of adrenalin ointment into the nostril, pinching the external nose against the septum for about five minutes without relaxing the pressure. This will usually stop the bleeding. Cracked ice to the forehead and dorsum of the nose in a suitable appliance (ice-water bag) may be used as an adjunct.

The *chromic acid bead* on a suitable metal applicator is another effective agent for arresting hemorrhage from the anterior nose. The technic in its preparation follows.

... using normal tissue

For the use of *trichloroacetic acid*, the bleeding point is touched with a pointed, cottoned applicator wet with the solution. Superficial or

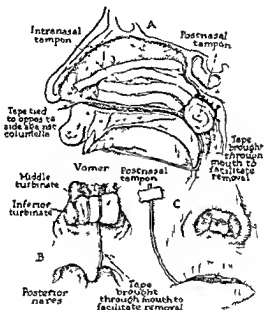


Fig. 19—Application of postnasal and intranasal tampons (From L. Z. Fishman)

*Silver nitrate* is applied readily with already prepared wooden applicators (handily supplied commercially). The stick is used in the same manner as the chromic acid bead.

Recurrent hemorrhage in association with hypertension may cause serious concern. Although "nasal phlebotomy" may act as a check valve in the hypertensive patient occasionally serious after effects

the most frequent area being a plexus of vessels similar in appearance to Kiesselbach's area, along the lateral wall of the nose just posterior

and slightly superior to the posterior tip of the inferior turbinate, near its junction with the lateral wall of the nasopharynx

In posterior nasal bleeding a posterior pack or plug is often a prerequisite to other therapeutic means of control. The technic of placement of a posterior pack is as follows (see also Fig. 19)

A posterior plug of cotton or gauze about  $2\frac{1}{2}$  inches long is introduced by a soft rubber catheter (usually No. 14 or 16 F) through the nose and brought out through the mouth. The pack is tied securely with either  $\frac{1}{8}$  inch self-edged tracheotomy tape or heavy ribbed black silk in such a manner as to contain two tails that are tied onto a rubber catheter on either side of the nose and one tail that presents itself through the patient's mouth. The two coming through the nose are tied onto a small gauze section at the columella of the nose.

In children the pediatric procedure of "mummifying" restraints is used and with a gagging maneuver a Jennings mouth retractor is applied. When the posterior pack is ready for removal one simply cuts the nasal ties at the columella and quickly loosens the pack by tugging the end coming from the mouth. A double rubber catheter may be ideal for inspecting the lower portion of the nasopharynx. Occasionally bleeding from an aberrant vascular plexus is detected and thereby directly controlled.

In addition to the posterior pack, an anterior pack may be required to control the bleeding. Either long fibered cotton soaked in 1:1000 adrenalin solution or ointment or treated in the manner Woodruff describes may be used. Woodruff's method consists in placing the tampons in a solution of 4 per cent antipyrine and following with 4 per cent tannic acid. The resultant mixture creates a plastic substance which has an excellent hemostatic effect.

In children hypnotics are a valuable adjunct.

Oxyel used as an anterior pack seems to be helpful as are cut sections of Simpson splints which act in a similar manner.

Another useful procedure is to infiltrate submucously the area surrounding a bleeding site with 1 per cent novocaine, epinephrine or a sclerosing agent like sylnasol or monolate.

A tamponade consisting of a latex balloon connected with rubber tubing or urinary catheter to a sphygmomanometer bulb and rapidly inflated by the patient proved excellent in controlling severe recurrent episodes of exsanguinating bleeding from the nose in Weber-Rendu-Osler's disease which is characterized by telangiectases which erode into large vascular branches and bleed profusely.

In severe bleeding or extreme situations failure to control bleeding by topical methods makes it imperative to resort to external carotid artery ligation.

Of other methods for control one may mention submucous resection, vitamin K administration or the use of snake venom, radium or thromboplastin.

**Hematoma of the Nasal Septum**—Closely related to epistaxis are hematomas which involve the nasal septum. These usually occur anteriorly, separating the mucoperichondrium from the cartilage and are characterized by soft ballooning noticed on the mucosal lining of the septum. Frequently hematomas result from trauma as in boxing or basketball or from surgery, as submucous resection; less frequently they are of systemic origin, as in scurvy and hemophilia. Of most concern besides obstruction is the frequent occurrence of secondary infection with formation of a septal abscess. This may include the cartilage, in which a chondritis occurs with subsequent loss of structure and occurrence of saddle nose or other external deformities. Perforating injuries through the external nose are a most distressing complication in children. Early drainage may be afforded after an esthetization of the mucosa of the nose and injection locally of novocain adrenalin solution using a Bard Parker knife with a No. 15 blade. A curvilinear incision is made very similar to the one made for a submucous resection and a tiny drain of iodoform gauze or rubber is inserted and maintained in place externally with a small piece of adhesive. Usually an organized clot is present. An ideal method of removal of the clot if suction fails, is the introduction of a small spatula after the nose is anesthetized and petrolatum applied for lubrication, compressing the mass posteriorly along the septum, advancing the curved blade in springlike action anteriorly to express the clot. Hematomas following surgery may require the use of another blade to be placed on the opposite side of the nose so as to offer resistance to the pressing spatula. Frequently, since mucosal structures heal so rapidly there may be another accumulation of blood and the wound needs to be reopened. Chronic hematomas may require radiation therapy in an effort to resolve some of the swelling. Calcific deposits may occur in the organization of the clot.

**Nasal Fractures**—Fractures of the nose may be simple or compound. In addition to fracture of the nasal bones there may be an associated fracture bending or displacement of the septum. The extent of swelling and deformity depends on the severity of the injury. Examination yields distinct crepitus if the lateral nasal bones are fractured. Ecchymosis about the eyes ensues. Inspection of the interior

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Improved cosmetic results are attained by prompt treatment combining intranasal and extranasal manipulations to adjust the fragments and bring the nose into alignment. Petrolatum gauze, stuffed finger

cots or specially prepared cotton splints are employed for the interior of the nose while dental compounds malleable metal and special viselike splints are useful to hold the external nose in proper position. Where parts need to be immobilized for some time special apparatus with adjustable traction and pressure points are necessary.

**Foreign Bodies in the Nasal Cavity**—Foreign bodies within the nasal cavity which may consist of objects of various design and material are frequently noted in young children. Usually the foreign body lodges quite anteriorly and with good illumination restraint and occasionally local anesthesia may readily be grasped with forceps and extracted. Nasal bleeding frequently occurs and is readily controlled. Calcific masses (rhinoliths) are rarely met with and are usually due to foreign bodies lodged within the nose over long periods of time. X ray examination may aid in localization.

**Chronic Hyperplastic Rhinitis**—Chronic hyperplastic rhinitis

in uncomplicated cases. Several stages are recognized such as the initial or dry stage which consists mostly of a feeling of clogginess of the nose, a watery or catarrhal stage and then lastly a purulent or suppurative stage in which considerable pus is obtained. The last stage results from secondary invading pathogenic bacteria which may be usual inhabitants within various patients and come to fore when the initial virus attack ensues. Should this latter stage persist over a longer period of time a residual pansinusitis is apt to occur. Those cases most prone to the latter type reveal on careful analysis and examination an underlying allergic diathesis. The frequency of colds, the increase of lymphoid hyperplasia of the tissues comprising Waldeyer's ring, the hyperplasia of the mucosal and submucosal structures that occur and lead on to the eventual chronicity indeed have a definite allergic background. This may be more manifest at times and quite subclinical or borderline at other times within the same patient.

The residual pansinusitis which usually follows in the wake of the cold is best managed by simple mechanical irrigation preceded by shrinkage with ephedrine. Usually a freshly prepared 1 to 2 per cent ephedrine solution to be used at frequent intervals in a handy DeVilbiss No. 31 spray is prescribed. After shrinkage with the ephedrine administered in this manner or with tampons made of cotton, a posterior irrigation (Proetz) is performed. After ten minutes allowed for adequate shrinkage the patient is told to lie on his back with his head in a lowered position (the nasal columella parallel with the ceiling) and a warmed physiologic saline solution is instilled into the nasal cavity. Suction pressure of less than 180 mm. of mercury is applied to the nose as the patient says "k k k." The latter brings the soft palate into occlusal position postnasally so as to effect suc-

tion After several applications to either side, the patient is returned to normal position

Hyperplastic areas may frequently be encountered and lead to

The entire surrounding tissues, the nasal septum and lateral walls of the nose (turbinates and meati) are anesthetized with tampons containing 4 per cent cocaine With adequate illumination, a cold wire snare is introduced first parallel with the nasal septum, inferiorly and catching within the wire loop the inferior border of the polyp The snare is then threaded over the polyp and directed in an upward and slanting angle of about 45 degrees and the snare is slowly applied Bleeding that occurs immediately afterwards is self limiting or may be readily stopped with a plain tampon or one treated with small amount of adrenalin solution

Hyperplastic turbinates are sometimes treated with submucous injections of synasol or monolate This method consists of using a fine gauge long needle ( $1\frac{1}{2}$  inches), No 22 or 24, with a tuberculin syringe or directly cauterizing with electrocautery An emphatic word of caution is necessary here In most instances such hyperplastic changes are accounted for by an allergic factor Destructive procedures applied to mucosal surfaces readily invite secondary and persistent infections Certainly the cause is not removed in these cases by cautery or the use of caustics and at best only temporary relief occasionally is afforded

Ceallulitis.—Small patches of cellulitis averaging 2 cm or larger about the nose, mouth or eyes, consisting of slightly reddened elevations of the skin and slight tenderness, may account for considerable systemic reaction Temperatures up to 102° F and over with malaise, lassitude and generalized myalgia may be present Recognition is of prime importance, for these readily and swiftly respond to chemotherapy Penicillin or sulfonamides in usual dosages are highly effective Those employed in meat packing industry or butchers are most commonly infected

Furuncles.—A furuncle within the vestibule of the nose, along the

proved the prognosis of cavernous sinus infection

## PHARYNGEAL MINOR SURGERY

**Adenoid Remnants—Adenoidectomy.**—Adenoidectomy, as routinely performed more or less blindly or by means of palpation, is essentially a most incomplete method of eradication of the adenoids. Certain patients particularly those allergic individuals who frequently come down with secondary infections or residual pansinusitis following their frequent colds, show a strong tendency to develop lymphoid hyperplasia and "recurrence of adenoids" or compensatory hyperplasia. Following incomplete removal of adenoids large remnants of adenoids may  
to otologic dis-  
torus tubarius



Fig. 20 Peritonsillar abscess involving the left side illustrating the evacuation through the supratonsillar fossa with a curved forceps and opening through the anterior pillar with a bistoury knife (Lederer Diseases of the Ear Nose and Throat 5th ed Philadelphia F. A. Davis Co. 1947)

with proper physiology of closure of the orifice. Nasopharyngeal application of radium under visual guidance of a Holmes nasopharyngoscope is of considerable therapeutic importance. The applicator consists of a shielded barrel containing 50 mg of radium sulfate encased in monel metal. This is applied to each side of the nasopharynx with the patient lying on a couch. A series of three treatments may be required at intervals of two weeks. No

release process. The usual acute phase of tonsillitis frequently caused by beta hemolytic streptococci occurs. There are the usual con



stitutional symptoms—fever malaise general aching pains sweats.

marked pain occur with marked swelling and edema over the entire side of the soft palate

The presence of supratonsillar sinus—a congenital remnant—which serves as a pathway of infection may explain why some cases of tonsillitis go on to peritonsillar abscess and others do not. For this reason the superior pole of the tonsils should be given prime attention in complete tonsillectomy. The base and lateral bands are not so important surgically.

Incision and drainage of a peritonsillar abscess in adults (Fig 20) are at times best performed without any local anesthesia. A suction apparatus is a convenient adjunct. Healing quickly occurs. The so-called chronic peritonsillar abscess in which incision results in little or no drainage may prove to be a granuloma (gumma of syphilis) or a malignant growth.

The so-called acute peritonsillitis in which an incision is made without recovery of pus may reveal itself in reality as diphtheria which is characterized by a low grade fever with relatively rapid pulse, lack of local fluctuation, general toxicity, gradual progression of symptoms, bilateral involvement and positive culture for Klebs-Loeffer bacillus. If these findings are present diphtheria antitoxin is immediately given.

**Retropharyngeal Abscess**—A retropharyngeal abscess is an abscess situated between the posterior wall of the pharynx and the vertebral column. While it occurs in adults it is commonly considered a disease of marasmic and underdeveloped infants and children between the ages of 3 months and 5 years.

Inspection and palpation disclose a rounded, red, smooth paramedian protrusion of the posterior pharyngeal wall pushing the pillars and soft palate forward. The diagnosis of retropharyngeal abscess is ordinarily made on a history of upper respiratory tract infection, dysphagia, inspiratory dyspnea and cervical adenitis in addition to the other findings mentioned. The x-ray is occasionally helpful in

The typical case of acute retropharyngeal abscess of lymphatic

or  
is

**Treatment**—In the prodromal stages of adenitis and periauricular one should localize the infection by hot moist compresses to the neck, steam inhalations and warm gargles. Supportive measures should con-

sist of adequate feeding and elimination of body wastes. Plenty of fluid must be given by mouth if possible perorally. Chemotherapy in the form of tasty antibiotics sulfonamides by mouth or repeated penicillin injections of 200 000 units in oil and wax (Romansky formula) every eight hours is of considerable help. Of additional value is suction of the secretion from within the nose and pharynx.

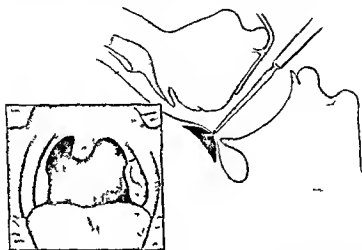


Fig 21—Retropharyngeal abscess. The incision of the abscess is schematically represented with the lead tied over the edge of the table to prevent aspiration of pus (Lederer, Diseases of the Ear, Nose and Throat, 5th ed. Philadelphia: F. A. Davis Co., 1947).

In the suppurative stage the one curative treatment is incision by the intraoral or the external route. The *intraoral technique* is employed for the uncomplicated abscess as follows (see also Fig 21):

General anesthesia should not be employed. Aspiration of pus must be avoided by carrying out a carefully planned technique. The patient is placed on a tilted table almost Trendelenburg position.

A long bistoury or tonsil knife is introduced and the abscess cut and pus is evacuated with the aid of suction.

The extension of the process into the pharyngomaxillary space is an indication for external incision anterior or posterior to the sternocleidomastoid muscle depending upon the location of pus in the individual case. The approach to the abscess is mainly by blunt dissection. A submaxillary approach may be of aid.

**Control of Hemorrhage**—Hemorrhage sometimes becomes so severe and repeated as to necessitate ligation of the large vessels of the neck. A first hemorrhage is an indication for ligation, it is a grave error to wait for the second or third, which may lead to a fatal termination. Transfusion of whole blood is indicated when there is extensive blood loss or marked secondary anemia.

**Nasopharyngeal Bursa**—The formation of an abscess in the region of the median recess of the nasopharynx can result from two distinct pathologic processes. Characteristically these abscesses are to be found in the midline. One type develops as a result of adhesions be-

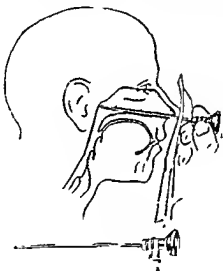


Fig. 22. The  
constructed along the  
floor of the nose  
and Throat, 5th ed.

quently follows, causing putrefaction prolonged retention gives rise to an abscess.

**Diagnosis**—One sees through the direct nasopharyngeal speculum or by means of the electrically lighted nasopharyngoscope (Fig. 22)

a swelling in the nasopharynx, it is either a rounded mass, deep red in color, or grayish and polypoid in appearance, or merely a flattening out of the normal concavity of the nasopharynx. The tissue is soft and easily penetrated by a probe alongside of which its contents are exuded.

*Treatment*—The treatment is as follows

extirpation is required



Fig. 23 Hollender's modification of the Yankauer instrument obviates the necessity for indirect illumination, since its proximal illumination provides this adequately (Lederer Diseases of the Ear, Nose and Throat 5th ed. Philadelphia, F. A. Davis Co. 1947)

**Tumors of the Pharynx.**—Tumors of the pharynx intrinsically are primary in character. Those of metastatic or more general origin are the result of changes in the lymphoid elements within the pharyngeal mucosa, as, for example, in leukemic states, lymphosarcoma, or the more common lymphatic hyperplasia. The diagnosis of these tumors is not readily differentiated from that of the benign lymphatic hyperplasia by logic examination. Pharyngeal tumors are most frequently located early on the lateral walls and in the process of extension involve the surrounding structures. Neoplastic, granulomatous masses in general occur in the fol-

lowing order of frequency. papilloma, gumma, sarcoma, carcinoma, lupus, cyst, polyp, fibroma, osteoma, chondroma, adenoma, lipoma,

ide the course of  
in type, must be

Most neoplasms may readily be biopsied following topical application of anesthesia, 2 per cent pontocaine or 4 per cent cocaine. Occasionally it may be necessary to infiltrate with 1 per cent novocain adrenalin solution. A punch forceps near the base of the tumor is used

## BENIGN LESIONS OF THE BREAST

HARRY A. OBERHELMAN, M.D., F.A.C.S.\*

In discussing benign lesions of the breast it becomes quite necessary for one to specify just what lesions are included. It is the purpose of the author to limit this discussion to the various forms of benign tumors and those multiplicity of lesions represented by chronic cystic mastitis. To exclude entirely all malignant forms of tumors may not always be possible because not infrequently in the highly proliferative forms of chronic cystic mastitis the differentiation between benignancy and malignancy cannot easily be made either clinically or pathologically.

In a survey of 556 consecutive operations for breast lesions of all kinds 75 per cent were benign. Of these 75 per cent were benign tumors and 25 per cent were chronic cystic mastitis. This indicates that more than half of the surgical lesions of the breast are of a benign character.

In a brief analysis of the 318 benign lesions 102 were considered benign tumors and 216 were chronic cystic mastitis. There were 15 lipomas, 7 fibromas, and 1 angioma. There were 15 in all. In similar fashion tumors of purely connective tissue origin are equally rare and accounted for 16 of which there were 8 lipomas, 7 fibromas, and 1 angioma. The most common form of benign tumor consists of both epithelial and connective tissue origin often referred to as benign tumors of mixed tissue origin. These are not to be confused with another group of tumors designated by the same name but containing myxomatous, cartilaginous or even osseous tissues. These latter forms are rare and only four of this type were encountered in the author's series which proved to be intracanalicular myxomas or the so called cystosarcoma phyllodes. Of the 102 benign tumors 71 consisted of both epithelial and connective tissue origin of these 4 as just mentioned the remaining 67 being made up of 42 intracanalicular fibroadenomas and 25 pericanalicular fibroadenomas.

In attempting to establish a classification of the variety of lesions that occur in chronic cystic mastitis one is at once confronted with a multiplicity of names used to designate these lesions. After long study

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of chronic cystic mastitis, *not only in this series but in a large series of cancerous breasts*, the author, for the sake of simplicity, found it very much in order to classify all these lesions into (1) a nonproliferative and (2) a proliferative group. In the 216 patients operated upon for chronic cystic mastitis 84 were of the nonproliferative and 122 of the proliferative form.

### BENIGN TUMORS OF EPITHELIAL ORIGIN

As already stated, pure epithelial tumors of the benign type are rare. When the epithelial tissue is predominant whether arranged in adenomatous or papillomatous forms the tumor takes the name of

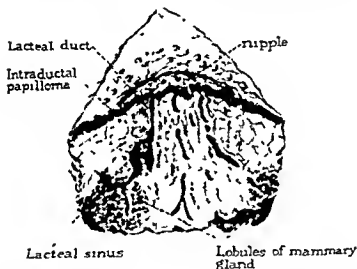


Fig. 24—Intraductal papilloma at the base of the nipple causing bleeding

adenoma and papilloma respectively. The adenomas occur in the lobules of the breast where the acini predominate and occur as circumscribed encapsulated nodules seldom more than 1 or 2 cm. in diameter. They are usually of a yellowish and pink gray. They are usually symptomless for the most part or by her physical examination they are freely movable. In palpation they are freely movable and do not cause any retraction of the skin.

Papillomas occur in the ducts often close to the base of the nipple (Figs 24, 25) or in varying distances away



Fig 25—The histopathology of the intraductal papilloma in Figure 24

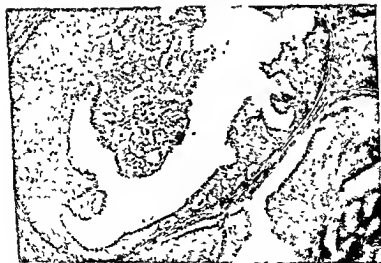


Fig 26—Intracystic adenopapilloma in chronic cystic mastitis in a breast removed for cancer. The lesion is a proliferative type of chronic cystic mastitis



from the base. They may also occur as combinations of both adenomatous and papillomatous forms within cysts of the breast in chronic cystic mastitis (Fig. 26). Papillomas are seldom palpable, and their presence is solely manifested by a discharge from the nipple usually first noticed by the patient as a stain on her clothing. This discharge

significance. On the other hand if the discharge is brown it has a pathologic significance. By carefully watching from which direction the nipple and surrounding breast tissue are gently milked, one can determine in what direction from the nipple the papilloma lies.

### BENIGN CONNECTIVE TISSUE TUMORS

The true incidence of connective tissue tumors is difficult to ascertain. The records are not always clear in the author's series as to whether the tumor was actually removed from the breast substance, or whether it was removed from just beneath the skin overlying the breasts and in no way connected with the breast tissue. Both lipomas and fibromas are far more frequently subcutaneous tumors over the breast than tumors within the breast. As tumors within the breast, they are encapsulated, freely movable and without symptoms.

### BENIGN TUMORS OF BOTH EPITHELIAL AND CONNECTIVE TISSUE ORIGIN

By far the largest group of benign tumors are of this type. They all develop within the breast substance. If one should appear as a subcutaneous tumor, it might be of sweat gland origin. In the breast they develop as intracanalicular or pericanalicular fibroadenomas, occur in young women, may remain

diameter greater

anter of an English walnut (Fig. 41). They are freely movable, encapsulated, uniformly firm and, on section, the surface is gray white and finely studded with small slightly raised circumscribed areas. Microscopically they present a most characteristic appearance. The intracanalicular form of fibroadenoma (Fig. 28) appears to be more or less a mature or a more advanced form of the pericanalicular fibroadenoma (Fig. 29). In the latter form the highly cellular connective tissue stroma appears not to have as yet proliferated to the extent

designated by Johannes Müller<sup>1</sup> in 1838 to convey its cauliflower and

polypoid like appearance Virchow<sup>2</sup> called this condition intracanalicular myxoma. A comprehensive study of this condition was made by

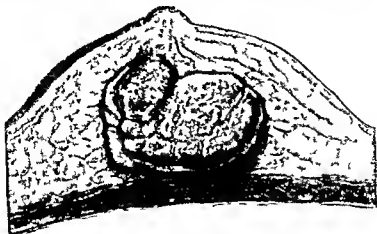


Fig. 27—One of the larger encapsulated fibroadenomas of the breast

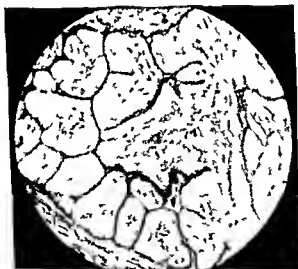


Fig. 28—A photomicrograph of the typical intracanalicular fibroadenoma

Lee and Pack<sup>3</sup> who analyzed 109 cases calling attention to their large size slow growth usually developing from preexisting fibroadenomas and the good result from surgical treatment. These tumors may re-

place much of the breast parenchyma and, if so are best treated by simple mastectomy



Fig. 29—A photomicrograph of the typical pericanalicular fibroadenoma

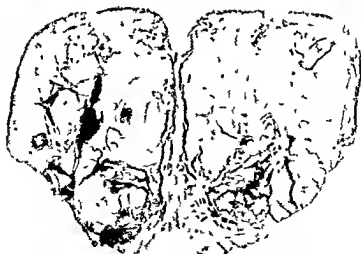


Fig. 30—Cystosarcoma phylloides or intracanalicular myxoma, a benign tumor

## TREATMENT OF BENIGN BREAST TUMORS

The treatment of benign tumors of the female breast is always surgical. This applies equally as much to subcutaneous tumors if they be beneath the skin over the breast or even in the vicinity of the breast. Should they occur in the so called embryonic milk line one must consider them as possibly accessory breast tissue. However if these subcutaneous tumors be on the anterior axillary fold or in the axilla they may represent aberrant breast tissue or a fibroadenoma in such breast tissue. Unless these tumors are strictly subcutaneous

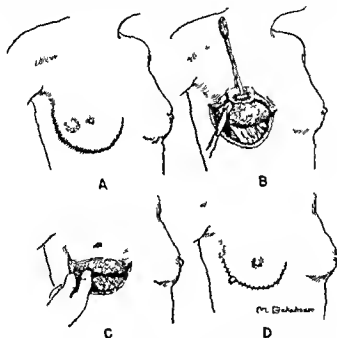


Fig. 31. Illustrating the Warren incision for excision of local tumors or simple mastectomy.

such a tumor may be excised under local anesthesia. However when they occur in the breast parenchyma local anesthesia should preferably not be employed because it is quite important that the surgeon see the tumor in its normal relationship to the surrounding breast tissue which is not possible when the tissues are flooded and distended with local anesthesia. This tends to definitely distort the normal relationship. Therefore a general anesthetic should be used preferably pentothal sodium intravenously with morphine and atropine as preoperative medication. Ethylene or cyclopropane are equally satisfactory. As to the incision for the removal of a benign breast tumor

the author strongly recommends the so-called Warren incision (Fig 31). This incision follows the thoracmammary groove and may extend the full length or even beyond if necessary to excise the tumor. Regardless of the location of the benign tumors, the author has yet to fail to remove such tumors through such an incision. The advantage of this incision is that it allows complete direct inspection and direct palpation of the entire posterior surface of the breast. This reveals the relationship between the tumor and the surrounding breast tissue, whether there is retraction or contraction which represent significant signs of malignancy and which cannot be determined always when the breast is approached directly from the front, without cutting into the tissues. Furthermore, the Warren incision yields an ideal cosmetic result, which the author considers most significant for the patient. The scar is for the most part concealed, whereas the scar of any other incision is boldly visible on the front of the breast, often presenting quite a disfigurement.

When a small part of the breast parenchyma is excised, the cut surfaces may be approximated with catgut sutures to obliterate the dead space. If an appreciable amount of breast tissue is excised, no attempt should be made to reapproximate the cut surfaces, because too much distortion will result and interfere with the restoration of the normal contour of the breast. The author instead of approximating the cut surfaces has permitted the defect to become filled with a blood clot, which in the process of organization serves as a "filler" and at the same time affords a scaffold for connective tissue regeneration and fat deposition. The incision is closed by subcutaneous catgut and cutaneous silk after placing a small Penrose drain beneath the breast.

semicircular incision is made at the periphery of the alveolar duct system. The incision is closed by the brown lythin duct passed peripherally to the papilloma to facilitate excision. The incision is closed with fine silk, leaving a scar hardly visible.

### CHRONIC CYSTIC MASTITIS

In order more fully to understand the term "chronic cystic mastitis" with all its various manifestations it is essential that one should have some knowledge of the various anatomic alterations that the female breast normally passes through as a result of the action of the various hormones during the life cycle of the individual.

formation of cords of columnar epithelial cells with the formation of acini. This however is a passing phase. Then from the end of the second year to puberty the breast is mainly stroma with 12 to 15 ducts converging at the nipple. At puberty the breast receives a stimulus the estrogenic hormone an ovarian secretion that causes a budding of the ducts into acini to give to the virgin breast its normal lobular markings. During the normal menstrual cycle both estrogen and progesterin a corpus luteum hormone cause a definite acinar hyperplasia during the premenstrual phase causing tenderness and swelling of the breasts. This premenstrual phase is also known as the hyperplastic phase or the progressive phase while the menstrual and the immediate postmenstrual phase represents the aplastic or regressive phase. This phase terminates at the midmenstrual ovulation time when the hyperplastic phase begins again to complete the cycle. With each menstrual cycle unless interrupted by pregnancy or the menopause there are the alternating hyperplastic and aplastic phases of the menstrual cycle each month. In the event of pregnancy progesterin produces further glandular hyperplasia that transcends by far the premenstrual hyperplasia. In the later stages of pregnancy a milk secreting hormone prolactin is formed by the anterior pituitary which stimulates the acinar structures to actual milk secretion. It is now that the breast functions to its greatest capacity and as a result has attained its highest level of glandular hyperplasia. In fact this glandular hyperplasia reaches such a degree of anatomic alteration that all semblance to the normal nonlactating breast structure is obliterated. The breast is practically all acinar tissue with the existing stroma so thinly spread out that it is hardly visible even in microscopic sections. When lactation ceases the acinar tissue undergoes a progressive regression or aplasia until the breast has resumed its normal nonlactating status. As soon as the menstrual cycle becomes restored the breast again returns to its alternating glandular premenstrual hyperplasia and the postmenstrual glandular aplasia. After the menopause ovarian activity ceases seemingly and the breasts then embark upon a progressive regression or the sustained senile involutional phase of growth.

alt

ancient normal physiology the development of any abnormal anatomic alterations would logically have to be the result of an abnormally balanced hormonal physiology or in short the result of an endocrine imbalance or ovarian dysfunction. In fact it is now more or less generally accepted that the various types of anatomic lesions in chronic cystic mastitis are the result of prolonged or repeated periods of endocrine imbalance due probably to ovarian dysfunction.

This was recognized by Sir Astley Cooper<sup>4</sup> 1829 when he called attention to a clinical relationship between certain menstrual abnor-

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bal

mabties or anatomic lesions in the pelvis and disorders of the mammary gland as did Velpeau<sup>3</sup> 1854. It remained for Rosenberg<sup>6</sup> 1922 to provide evidence first establishing the fact that the cyclic variations in the human breast were directly related to cyclic changes in the ovaries. He noted that in each premenstruum there were budding outgrowths of the terminal ducts forming acini coincident with an

acini did not regress as Rosenberg had reported and explained this on the basis that the female breast does not develop its maximum capacity to acquire acini until after the age of 20 and that after that age some of the premenstrual acini persist in the intermenstruum. On the contrary Taylor<sup>4</sup> concluded from his studies that the relation between estrogenic hormones and breast alterations is probably over emphasized. Nevertheless the clinical and experimental evidence so far accumulated logically points to a definite relationship between endocrine imbalance and chronic cystic mastitis.

Since the clinical and pathological features of chronic cystic mastitis are generally quite familiar to the surgeon and pathologist there has been a decided lack of uniformity as to what name should be given to this condition. This has caused much confusion during the past years in so far as nomenclature is concerned. Whether or not the different types of chronic cystic mastitis lesions represent different stages of the same disease or whether they are separate disease entities still seem to lack uniform agreement.

A brief evolution of the nomenclature might be considered. Sir Astley Cooper<sup>4</sup> 1829 called the disease "cellulous hydatids" in 1846 Brodie<sup>5</sup> used the term "serocystic tumors" while Billroth<sup>10</sup> selected the name of "retention cysts." The first complete anatomicopathological description was made by Reclus<sup>11</sup> 1883 who used the term "cystic disease of the mammary gland." Schummellrusch<sup>12</sup> by whose name

another By calling the conditions *serocystic* is probably quite correct. More recently Cheattle<sup>18</sup> suggested a rather elaborate name "cystiferous desquamative epithelial hyperplasia." The term "fibrocystic disease" was suggested by Bevan<sup>21</sup> 1935 and is the term the author prefers to use. However due to long and continued use of the term "chronic cystic mastitis" it has come to stay.

Cole and Rossiter<sup>13 16</sup> is a very practical one in which they discuss four types (1) The adenofibrosis type which is for the most part a proliferation of fibrous tissue containing scattered groups of acini (2) The benign parenchymatous hyperplasia consisting of prolifera



Fig. 32—Multiple simple blue-domed cysts (Bloodgood) in nonproliferative chronic cystic mastitis

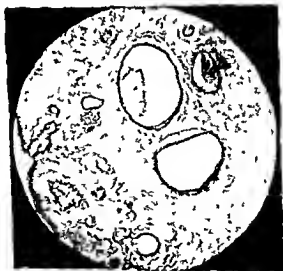


Fig. 33—Photomicrograph of simple nonproliferative chronic cystic mastitis

tion of the epithelial structures of the glands and ducts (3) The pre-cancerous hyperplasia representing a high grade of atypical epithelial hyperplasia with mitosis (4) Cystic disease which consists of localized cysts formed largely during the process of involution



The author feels that for the sake of even greater simplicity, the four forms just mentioned might be grouped into two main divisions. From the anatomic pathologic standpoint types 1 and 4 might well be considered the nonproliferative group and types 2 and 3 as the proliferative group. This is the classification preferred by the author because in the first place after one has examined innumerable slides *two* features of chronic cystic mastitis readily take shape and form. The one feature is predominantly cystic, with smooth lining cells of one or several layers deep or the stromal tissue shows a great deal of



Fig. 34—Photomicrograph of the "pale pink" epithelium (Schummelbusch) proliferation a milder form of the proliferative type of chronic cystic mastitis.

These findings are directly opposite to the nonproliferative feature and is predominantly an epithelial hyperplasia which may be in the form of the typical "pale pink" epithelium which Schummelbusch<sup>12</sup> regarded as pathognomonic of chronic cystic mastitis (Fig. 34) to the proliferation of adenomas, papillomas or combinations of adenopapillomas (Fig. 36). This group the author prefers to designate as the proliferative group. The proliferative

titis may be diffusely (Fig 35) or locally involved. On palpation the breast may contain numerous small shotlike cysts or single or multiple spherical masses up to 4 or 5 cm in diameter (Fig 32), or there may be a sectional induration. It is not uncommon for both breasts to be involved. The masses are movable usually circumscribed and quite resistant depending upon the intracystic tension. Their presence is usually discovered by pain and tenderness which is the outstanding symptom and is most marked during the hyperplastic phase of the menstrual cycle when the lesions and breasts increase in size. Sometimes the cystic lesions are accidentally discovered by the patient while bathing. In the aplastic phase of the menstrual cycle

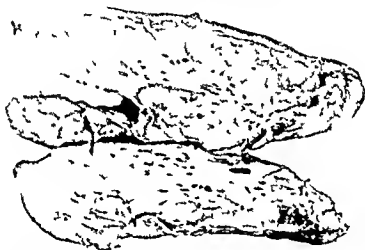


Fig 35—Diffuse and generalized chronic cystic mastitis showing many cysts which correspond to the "shotlike" nodules palpated clinically

the pain and tenderness materially subside and the lesions become smaller. It is not always possible to differentiate the nonproliferative lesions from the proliferative. The nonproliferative are more apt to be rounded.

As far as the location of the lesions is concerned, they are likely to be in the upper outer quadrant in these lesions. It is a rare finding in the author's experience, and when it occurs it is more apt to come from the proliferative type of chronic

pendulous the lesion may be transilluminated. In this way its degree of chronicity can be ascertained. If the lesion is sufficiently large, it may be palpable as a distinct mass.

of transparency, if any, may be determined. Aspiration will also disclose whether the mass is cystic or solid. The author, however, feels that, if gentle palpation and inspection of the breast fail to reveal the true nature of the lesion, biopsy should be resorted to for accurate diagnosis. To correctly palpate the breasts, the patient must be lying flat on her back, with the arms outstretched and the hands folded behind the head, with the breast thus relaxed and more or less evenly spread over the anterior chest wall. The surgeon then lays the open hand over the breast making gentle pressure over it. Any resistant or irregular nodules will be readily detected. If a woman over 35 or under 50 years of age, with one or more tender and painful nodules in her breast, that increase in size simultaneously with the hyperplastic phase of the menstrual cycle, and decrease with the aplastic phase, with the skin freely movable over the lesion or lesions, one can be fairly certain that the condition is one of chronic cystic mastitis or a benign tumor. Occasionally one cannot be entirely certain after careful physical examination whether the lesion is benign or malignant. A frozen section, however, at the time of surgery will provide the correct diagnosis.

**Treatment of Chronic Cystic Mastitis.**—The treatment may be conservative or surgical. Since it is generally conceded that chronic cystic mastitis is the result of an endocrine imbalance, one might logically assume if this endocrine imbalance is restored to a balanced endocrine level the lesions in chronic cystic mastitis should disappear. However, when attempts are made to administer therapeutically those hormones assumed to be deficient to restore the endocrine balance, the results of such attempts have been uniformly disappointing. Occasionally, such tumors may disappear during the aplastic phase of the menstrual cycle suggesting that when nature restores the endocrine balance, these lesions do disappear. The results thus far obtained through the use of such hormones as estrogen, progesterone and tes-

In many instances have  
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son<sup>20</sup> found no changes in the breasts which he could ascribe to hormone administration. Cole and Rossiter<sup>18</sup> suggest that if any hormone therapy is to be used stilbestrol (diethylstilbestrol) might offer some benefit. Therefore it seems that endocrine therapy as now administered is useless and that surgery is the only available means for relief. However, before surgery is employed, the patient should be kept under observation long enough to convince the surgeon that

after following the  
cycles to note what  
ises of the menstrual

cycle may have upon the lesion. . . . and if the patient has known of the lesion for several months then a period of observation

is not so essential although it is good sense for the surgeon to always follow the patient's condition through at least one menstrual cycle to determine for himself to what extent the physical and subjective signs of the lesion have been altered by the menstrual cycle.

**Surgical Treatment**—As in any grossly palpable lesion of the breast so in chronic cystic mastitis the treatment is always surgical. It is obvious that when we operate for the lesions in chronic cystic mastitis we are operating only those that are grossly palpable or in other words of macroscopic dimensions. The chronic cystic mastitis that can be detected by the microscope only is of microscopic dimension and therefore goes untreated since there is no way of detecting it clinically. In the event that chronic cystic mastitis should cause a bloody discharge from the nipple an exploratory search may have to be made to locate the lesion. The same type of anesthesia and the same type of incision recommended for the removal of benign breast

event that chronic cystic mastitis should cause a bloody discharge from the nipple an exploratory search may have to be made to locate the lesion. The same type of anesthesia and the same type of incision recommended for the removal of benign breast

sible transplantation of mammary gland.

When the surgeon has completed the excision of the lesions he should make multiple cut surfaces and search for malignancy. If no evidence of malignancy is found he may conclude the operation by making a subcutaneous catgut and a black silk cutaneous closure after a small Penrose drain has been placed behind the breast. Should the lesion be malignant the surgeon should change his gloves and scalpel close the Warren incision and then perform a radical or modified radical mastectomy. Not infrequently the pathologist may have difficulty in convincing himself that the lesion is malignant and expresses suspicion about the nature of the lesion. Under such conditions there is only one alternative for the surgeon and that is to carry out a radical or modified radical mastectomy.

#### THE RELATION OF CHRONIC CYSTIC MASTITIS TO CANCER OF THE BREAST

It seems that no discussion of chronic cystic mastitis is complete without making some mention of the controversial views on "Is chronic cystic mastitis or is it not a precancerous lesion?" There seems to be evidence supporting both views and much of the existing confusion has resulted from statistical studies on one hand histopathologic studies on the other. —and to the clinical and it mention of only a few reference this subject.

Such authors as Bloodgood<sup>14</sup> Campbell and Lewis<sup>21</sup> and Geschickler approaching chronic cystic mastitis from both the clinical and pathological angle state that it is not a precancerous lesion using large series of patients in follow up studies as a basis for their conclusions. On the other hand Cheate and Cutler<sup>22</sup> who based their conclusions on histopathological studies claim that 20 per cent of the lesions in chronic cystic mastitis are precancerous. Warren<sup>3</sup> conducting an unusual statistical study on this relationship states that women with chronic cystic mastitis lesions are more subject to breast cancer than women without such lesions. Cole and Rossiter<sup>18</sup> from their studies conclude that 20 to 30 per cent of patients with the proliferative type of lesions which they designate as precancerous possess possibilities of becoming cancerous.

Other investigators have attempted to find the answer to this relationship by studying the breasts of adult women at autopsy where death was in no way related to breast lesions or by studies of breasts removed at operations for gross lesions other than chronic cystic mastitis. Borchardt and Jaffe<sup>1</sup> studied the breasts of adult women in 100 autopsies and found microscopic evidence of chronic cystic mastitis in 93 per cent and in 65 per cent the lesions were of the proliferative type considered by some investigators as precancerous. They concluded that these lesions were not precancerous. Observations made by Semb<sup>6</sup> in microscopic studies on a large series of breasts removed for carcinoma found changes of chronic cystic mastitis in 80 per cent of the breasts in the extracancerous areas. McCarty<sup>27</sup> likewise reported similar changes in one thousand breasts removed for cancer. In studies by the author of 466 cancerous breasts in which no other grossly palpable lesion was present except the cancer itself 82.4 per cent revealed the presence of chronic cystic mastitis in the extracancerous areas and over half of these had the proliferative form. From such a high incidence of chronic cystic mastitis in cancerous breasts one might draw two conclusions one directly opposed to the other. One conclusion could be that because of the high incidence of chronic cystic mastitis and cancer occurring in the same breast that the lesion is surely precancerous the other conclusion and directly opposite could be that these changes are

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1  
balance and occurring in the breasts of all adult women. However we see that as it may the author feels that after weighing all the evidence at hand, in a limited number of instances in the highly proliferative forms such as the adenopapillomatous type the lesion may for all practical purposes be a precancerous one and should be treated as such by radical mastectomy.

## SUMMARY

1 In general approximately 60 per cent of all surgical lesions of the breast are benign

2 Benign tumors of pure epithelial or pure connective tissue origin are relatively rare, while benign tumors of both epithelial and connective tissue origin are common

3 Of all the benign lesions of the breast, those found in chronic cystic mastitis are the most common

4 The marked anatomic alteration in the breast, the result of hormonal stimulation during the premenstruum, pregnancy and lactation are discussed

5 It is now a commonly accepted view that the cause of chronic cystic mastitis is the result of an endocrine imbalance, due probably to ovarian and pituitary dysfunction.

6. A simple classification of the lesions in chronic cystic mastitis is suggested, the nonproliferative and the proliferative groups

7 The universality of the lesions in chronic cystic mastitis is suggested from the studies of breasts in routine autopsy and of breasts removed surgically for lesions other than chronic cystic mastitis. The term "involutional changes" has distinct application.

8 The treatment of chronic cystic mastitis with hormones with the hope of restoring the endocrine balance is uniformly disappointing

9 The accepted treatment of all benign lesions of the breast is surgical and the Warren incision is warmly recommended

10 The relationship of chronic cystic mastitis to carcinoma of the breast is discussed.

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## SKIN GRAFTS

PAUL W GREPLEY, M.D., F.A.C.S.\*

WOUND closure in modern terminology has become dependent to a large extent upon the utilization of skin grafting procedures. While all surface defects are covered ideally by the use of adjacent tissues, many wounds must, by the necessity of their size and location, be covered by a properly selected type of skin graft. By the term "properly selected," it is implied that thought and consideration be given to the choice of the type of graft for each individual problem that is encountered. Different varieties of grafts have differing cosmetic and physical characteristics and likewise, the simplicity or complexity of their transfer varies. Hence, it is very important to evaluate carefully each problem prior to deciding upon the method for each individual skin grafting operation. In other words, the surgeon must be familiar with the indications for the use of each different type of skin graft, and what each will offer in terms of the final net result.

Skin grafts can be made to grow successfully on practically any viable area that is not contaminated by major virulent infection or uncontrollable hemorrhage. Fresh surgical wounds make the most ideal base. Skin grafts will also grow on periosteum, bone, perichondrium, tendon, fascia, fat, muscle or healthy granulation tissue. Granulating beds however must be looked upon as infected fields. Even though this may be mild, the simpler types of grafts must be used when covering such an area.

Thinner the skin graft the greater will be its chance of growing completely. Conversely the thicker ones will be most difficult to make grow but will give the maximum degree of function and cosmesis. The decision as to what type of skin graft to use is not always an easy one to make, but the degree of uncertainty lessens as the surgeon's experience with various techniques increases. The inexperienced operator is apt to choose complicated methods when a simpler procedure would be more desirable, the latter often yielding better final results and simultaneously being time and discomfort saving to both the patient and the surgeon.

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mucous membrane in the mouth or nose, or for conjunctiva with which to line an eyelid. It will not, however, control the underlying fibrosis which invariably develops postoperatively, but it will survive where a graft of greater thickness might not grow. As a temporary measure, therefore, whether for a burn or other cutaneous defect, it can often be utilized to great advantage in facilitating rapid healing. Moreover, this covering may be excised later when the operative wound is clean

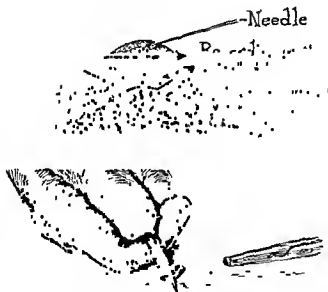


Fig. 37—Method of cutting "pinch" grafts (Courtesy U. S. Nav. Hosp., Oakland, Calif.)

procedure is not one of choice, but may be indicated as one of necessity in covering extensive granulating defects following third degree burns where donor sites are at a premium. Such small grafts of skin may be spread over extensive areas with open granulations left between. These intervening areas will heal spontaneously by scar tissue proliferation from the multiple skin graft edges. The result is lacking in both function and cosmesis because of the fibrosis. The method however is of considerable practical value when large surface areas must be covered and may be looked upon sometimes as a life saving measure. If possible one may use the procedure in combination with other methods, i.e., to use large grafts over joints where

## TYPES OF SKIN GRAFTS

The following simple classification of skin grafts is offered (Fig 36)

## Free grafts

## Split thickness

Thiersch

Postage stamp

Reverdin

Intermediate

Stent

## Free full thickness (Wolfe)

## Pedicle grafts

Open (direct)

Tubed

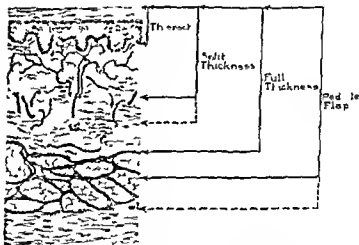


Fig 36—Showing thickness of different types of skin grafts in cross section (Reproduced courtesy U S Nav M Bull vol 42)

closed wound. It will grow when used as a substitute for bone, perichondrium, muscle, fascia, tendon, or as a substitute for

The mold and graft are then reinserted into the defect and pressure applied as with any other graft. The mold is removed in approximately one week at which time the graft will be found to be growing nicely.

**Free Full Thickness or Wolfe Grafts**—Free full thickness grafts will give the maximum degree of cosmetic and functional result, but are the most difficult in which to obtain growth. They are preferred

of all underlying fat and to a pattern of the exact size and shape of the defect. They must be secured in place with many small interrupted sutures. Hemostasis of the recipient area must be perfect. Pressure should be applied for fourteen to twenty one days although the graft may be inspected earlier for the removal of sutures if the pressure dressing is replaced promptly.

There is no known limit as to the size to which a free full thickness graft may be cut but large donor areas may present a serious problem in closure. Small donor areas may be closed by undermining and suture of the borders but large defects may have to be covered by some type of split thickness skin graft. Consequently there should be positive indications for its use when a free full thickness skin graft is selected.

**Pedicle Flaps**—These may be open or tubed. They are frequently utilized for extensive reconstructions about the face particularly about the mouth and tip of the nose where both covering and lining are needed and when there is not a good base against which pressure can be made. They are also indicated when it is doubtful whether the viability of the graft can be maintained and when it is necessary to transfer a subcutaneous fat pad with the graft. To cover defects of the hand either flexor or extensor when tendons have been exposed a flap containing a good subcutaneous fat pad is necessary but a free graft should be used always when an adequate subcutaneous fat pad remains over the tendons. In cutaneous defects about the jaw or extremities where the skin replacement is to be followed later by bone nerve or tendon surgery a pedicle flap should be used since it will tolerate subsequent reopening or incision through which the underlying surgery must be approached. One point must be remembered however and that is that any flap on the hand or fingers is always bulky and clumsy as compared with a free graft.

Whether one utilizes an open or direct flap or one which has been tubed depends upon several factors. Using the open flap is a more rapid procedure but the open surface is always subject to more or less contamination. This can be minimized if the donor area and any unused portion of the exposed surface is covered with a split thickness skin graft at the time of the primary operation. Small donor areas

maximum elasticity is desired and to use the small grafts over surface areas between joints

**Reverdin (Pinch or Davis) Grafts (Fig. 37)**—The Reverdin grafts may have a place in the hands of the occasional operator or to serve as a temporary covering. Like the postage stamp graft, their use may be considered when donor sites are at a premium. However, it is the experience of plastic surgeons that the percentage of takes is greater when larger thin sheets of skin such as Thiersch or postage stamp grafts are used.

The final functional and cosmetic result left with the Reverdin graft leaves much to be desired in both the recipient and donor areas. The scarring between the islands of skin frequently breaks down because of poor vascularity. Consequently Thiersch grafts appear preferable to the Reverdin or Davis types.

**Intermediate Split Thickness Grafts**—These grafts have the greatest field of usefulness of all the various types. These could be called thick Thiersch grafts. They may be cut from 25 to 85 per cent of the total skin thickness. The thicker ones embody many advantages of the free full thickness graft but at the same time are much simpler to utilize from the technical standpoint. They may be cut to almost unlimited surface dimensions. It is not necessary that they be cut to exact size of the area to be covered since any excess may be permitted to overlap. This redundancy may be trimmed off at the time of the first dressing. Furthermore the donor site heals spontaneously. Consequently thick split thickness grafts may be used for all practical

may even be used here providing a good subcutaneous is present on the recipient site. Even neck and axillary contractures do well when replaced with large thick split thickness skin grafts.

Another practical advantage of the split thickness graft is that repeated "crops" may be taken from the same donor site if the grafts have been cut relatively thin. Successive "crops" may be taken at three to four week intervals, a procedure that may be of utmost importance when extensive defects must be covered and when donor sites are usually at a premium.

**Stent Grafts**—Stent grafts are employed in providing an epithelial covering over irregular surfaces and in cavities where it is ordinarily difficult to obtain firm even pressure. This technical procedure can

wrapped around it with the raw surface of the graft placed

sectioning the base ("delaying") and then closing this incision by suture

### DONOR AREAS

These must be chosen with thought. They should be taken from a location wherein the secondary deformity can be hidden by the patient's clothing. It must be remembered that hair bearing areas must be avoided when transplanting pedicle flaps or free full thickness grafts unless one desires to transfer deliberately hair with the skin as in the construction of a new eyebrow. The accidental transfer of hair bearing skin must always be kept in mind. Patients will never thank the surgeon who inadvertently transplants a hair bearing skin graft to the palm of his hand!

An attempt should always be made to select a graft that will match the area to be covered both cosmetically and functionally. For smaller defects about the face a free full thickness graft from behind the ear, infraclavicular area, or inner aspect of the upper arm will yield the best cosmetic result. Unfortunately however, some Wolfe grafts placed on the face may ultimately pigment to an area darker than the surrounding normal skin. This annoying complication can in some instances be improved by tattooing.

The largest donor areas from which to obtain split thickness grafts are found on the abdomen, chest, back and thigh. The normal total thickness of any split skin graft varies with the donor site from which it is taken, i.e., whether it is from the back, abdomen, or thigh, and whether from a man, woman, or child. In other words, a graft cut with a dermatome set to 0.0024 inch thickness from the back where the skin is relatively thick would be carried into the subcutaneous fat if it were taken from the inner aspect of the thigh of the same patient.

### ISOGRAFTS

Skin grafts taken from other individuals are unsuccessful in light of our present knowledge except in identical twins. This latter consideration is too remote to have much practical significance. However, thin Thiersch isografts may grow from one to six weeks before melting away. This fact may be of value in the temporary covering of an extensively burned individual who is too ill to withstand an autogenous skin grafting procedure. While the success of this temporary graft must be looked upon as a permanent failure, the transitory viable covering may tide over a critically ill patient until autogenous skin grafting can be done successfully. Zoo grafting, the transfer of animal skin to humans, is spectacular but has not been successful.

### CHOICE OF SKIN GRAFTS

In deciding upon the type of skin graft to use in any given problem, the following factors must always be kept in mind. (1) The ease

may of course be closed by suturing. The tubed pedicle flap, however, is a closed mechanism throughout and is always the more desirable except for the additional time involved in its construction and transfer (Fig. 38).

The safe proportion of length and width of pedicle flaps varies somewhat with the blood supply of the area from which they are taken. Generally speaking, however, an average proportion is two and one-half times as long as the flap is wide. If a longer flap is needed, it should be elevated in sections, leaving a central bridge

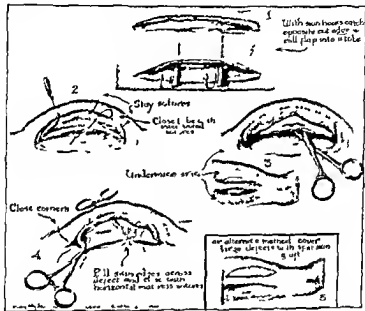


Fig. 38—Method of construction of tubed pedicle flap and two alternative methods of closing donor area from which flap was taken (Courtesy U S Nav Hosp., Oakland, Calif.)

attached until further blood supply develops in the ends of the tubed pedicle. Or, as Gillies has suggested, the length at the ends may be increased by interval stages.

The length of time necessary before a pedicle can be moved or divided varies. The average tubed pedicle flap must be left in place

ing this distance, grafts of different thickness may be cut with a high degree of accuracy and uniformity. A quick drying rubber cement is placed on the drum and donor skin area. When placed in contact the skin is held against the drum surface, while the graft is then cut by a to and fro motion of the knife-carrying lever.



Fig 39—Demonstrates application of free full thickness skin grafts to ring and little finger defects (Reproduced courtesy Am J Surg and U S Nat Hosp Oakland Calif)

Irrespective of which method is used to cut the graft the net skin graft is identically the same. All split thickness and free full thickness grafts are transferred to the recipient area and secured in place with fine nonabsorbable sutures. A layer of plain petrolatum gauze or 3 per cent xeroform petrolatum gauze is then laid over the graft.



with which the defect may be covered (2) The final cosmetic and functional result (3) The comfort and safety of the patient during the period of plastic surgical repair

It might be of interest to point out that in a total of 1411 skin graft

Split skin grafts	1 024
Reverdin grafts	28
Stent grafts	60
Free full thickness grafts	84
Pedicle flaps	215
Total	1 411

It is quite obvious from these figures that the split thickness type of graft is most commonly employed. These figures are quite proportionate to those of civilian practice except that in the latter one utilizes the Wolfe graft a little more frequently and a pedicle flap a little less often.

#### PLANNING THE TYPE OF REPAIR

In planning the type of repair of any cutaneous defect the surgeon must be able to visualize mentally the final result and then decide upon the steps necessary to arrive at this end. He should apply his selected graft as early as possible utilizing the simplest method that will give the desired cosmetic and functional result. If it is necessary to use some type of pedicle flap such a flap must be prepared completely prior to transfer before removing the pathologic lesion whether it be an ulcer, a simple contracture or a neoplasm.

#### METHODS OF CUTTING SKIN GRAFTS

Small pinch grafts either the thin Reverdin or thick Davis type may be cut with a scalpel (Fig. 37) after first lifting up the skin with the thumb nail. Full thickness grafts are likewise cut with a scalpel after the donor area around the defect has been covered. It must be free of all subcutaneous

fat in order to insure growth.

Split thickness skin grafts are most commonly removed by either the "Z-plasty" method and most rapid is to

ing this distance, grafts of different thickness may be cut with a high degree of accuracy and uniformity. A quick drying rubber cement is placed on the drum and donor skin area. When placed in contact, the skin is held against the drum surface, while the graft is then cut by a to and fro motion of the knife carrying lever.



Fig. 39—Demonstrates application of free full thickness skin grafts to ring and little finger defects (Reproduced courtesy Am. J. Surg. and U. S. Nav. Hosp., Oakland, Calif.)

Irrespective of which method is used to cut the graft, the net skin graft is identically the same. All split thickness and free full thickness grafts are transferred to the recipient area and secured in place with fine nonabsorbable sutures. A layer of plain petrolatum gauze, or 3 per cent veroform petrolatum gauze is then laid over the graft. This in turn is covered with sterile flat gauze pads, cotton waste, or abdominal pads. An ace bandage is then applied under mild pressure and, barring complications, the graft is not inspected for approxi-

with which the defect may be covered (2) The final cosmetic and functional result (3) The comfort and safety of the patient during the period of plastic surgical repair

Split skin grafts	1 024
Reverdin grafts	28
Stent grafts	60
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#### PLANNING THE TYPE OF REPAIR

Refer to the diagram

#### METHODS OF CUTTING SKIN GRAFTS

Small patch grafts either the thin Reverdin or thick Davis type

of two well standardized methods in which the graft is sliced off. One uses the free hand razor method in which the graft is sliced off. The other, using the Blair Brown suction method, is by use of

mately one week. The dressing is then opened and all sutures and any excess overlapping graft removed. Should hematoma be present the overlying portion of the graft is incised for drainage and the hematoma evacuated. Pressure dressings are then reapplied for one more week with split thickness grafts and for two weeks additional with full thickness types. When covering granulating defects that commonly are contaminated with *Bacillus pyocyaneus* earlier inspection of the graft is necessary, often within twenty four to forty eight hours. Should excessive suppuration be found at the first dressing moist dressing technic should then be substituted until the area is clean.

### REFRIGERATION OF SKIN GRAFTS

This procedure is successful when one wishes to preserve unused portions of the graft until it is needed. The graft is placed in a sterile jar or jar T in a sterile jar or jar T frozen state until wanted. After thawing it may be applied to the recipient area in the same manner as a freshly cut autogenous skin graft. These grafts are known to work successfully over a period of at least three to four weeks.

### "GLUING" TECHNIQUES

Procedures of this type have been currently popularized in many different publications. However they offer no practical aid and have been discarded by all plastic surgeons doing any large number of skin grafting operations. The step is unnecessary because nature makes its own natural physiological coagulum such as occurs in all wound healing. Furthermore considerable surface area is lost by virtue of contraction of the graft a process which does not occur when the graft is placed on normal skin tension and secured there by suturing.

### PREPARATION OF RECIPIENT AREA FOR SKIN GRAFTS

All fresh surgical wounds i.e. those created by the excision of healed scar contractures, neoplasms, or avulsions present ideal bases upon which to place a skin graft. They are more bacteriologically clean than any defect.

Contaminated wounds must be treated both systemically and locally. Systemic treatment consists in the use of adequate doses of penicillin and whole blood transfusions if the patient is anemic. Local treatment includes removal of any necrotic tissue or other foreign bodies, including bone sequestra. Following this the wound is covered with sterile fine rayon silk (if unavailable, fine mesh gauze) and copious moist dressings applied under slight pressure and kept constantly moist. Of the various solutions used, we have found saturated boric

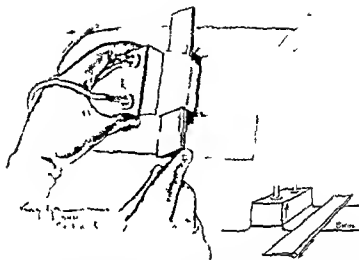


Fig 40—Method of cutting split thickness grafts by Blair Brown free hand technique (Courtesy U S Nav Hosp, Oakland Calif)

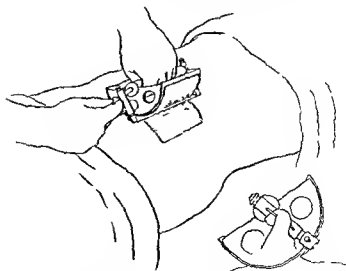


Fig 41—Method of cutting split thickness skin graft with Padgett dermatome

## LOCAL TREATMENT OF THE WHOLE THICKNESS BURN SURFACE

HARVEY S. ALLEN, M.D., F.A.C.S.\*

Most surgeons interested in the treatment of burns are agreed on the principles of care of burn shock and the initial local care of the burned surface. However, there is some apparent confusion as to the management of the patient after the burn shock has subsided. This is especially apparent in cases with whole thickness burn loss.

After completion of the primary local care to the burned wound and the control of burn shock, the patient enters a very critical phase of his injury. About forty-eight hours after the injury is an important time and the surgeon must have a definite plan of treatment: first in maintaining the patient in a stable nutritional condition and maintaining this throughout; and secondly, there must be a definite plan of treatment of the burned area.

It is neither possible nor logical to dissociate the problem of general care of the burned patient from the care of the local burn wound. The most recent worthwhile contributions to burn therapy have dealt with better understanding of the chemical alterations resulting from the burn and the logical methods of correcting these alterations. While this discussion will deal especially with care to the local wound, it must again be emphasized that at the same time the local wound is being treated, the general condition of the patient must be constantly observed and also treated. There is a definite correlation between the nutritional and chemical balance of the patient and his ability to heal in a normal manner or to combat infection.

After the burn shock has been

anticipated that the patient

and that a nitrogen imbalance

fourth day after the injury and every second day thereafter the patient's blood should be checked to determine the values of the hematocrit, the hemoglobin and the plasma protein levels. These few blood examinations are sufficient to indicate the patient's general condition, provided there is an adequate urinary output. Any significant lowering of these blood values must be corrected to keep them at a high normal level. A daily diet must be given high in vitamin content and containing two to three grams of protein per kilogram of body weight. Beginning about the fourth day the patient with a severe

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## LOCAL TREATMENT OF THE WHOLE THICKNESS BURN SURFACE

HARVEY S. ALLEN, M.D., F.A.C.S.\*

Most surgeons interested in the treatment of burns are agreed on the principles of care of burn shock and the initial local care of the burned surface. However, there is some apparent confusion as to the management of the patient after the burn shock has subsided. This is especially apparent in cases with whole thickness burn loss.

After completion of the primary local care to the burned wound and the control of burn shock, the patient enters a very critical phase of his injury. About forty eight hours after the injury is an important time and the surgeon must have a definite plan of treatment, first in maintaining the patient in a stable nutritional condition and maintaining this throughout, and secondly there must be a definite plan of treatment of the burned area.

It is neither possible nor logical to dissociate the problem of general care of the burned patient from the care of the local burn wound. The most recent worthwhile contributions to burn therapy have dealt with better understanding of the chemical alterations resulting from the burn and the logical methods of correcting these alterations. While this discussion will deal especially with care to the local wound, it must again be emphasized that at the same time the local wound is being treated the general condition of the patient must be constantly observed and also treated. There is a definite correlation between the nutritional and chemical balance of the patient and his ability to heal in a normal manner or to combat infection.

After the burn shock has been successfully combated, it should be anticipated that the patient will exhibit a serious secondary anemia and that a nitrogen imbalance will occur. Beginning the third or fourth day after the injury and every second day thereafter, the patient's blood should be checked to determine the values of the hematocrit, the hemoglobin and the plasma protein levels. These few blood examinations are sufficient to indicate the patient's general condition, provided there is an adequate urinary output. Any significant lowering of these blood values must be corrected to keep them at a high normal level. A daily diet must be given high in vitamin content and containing two to three grams of protein per kilogram of body weight. Beginning about the fourth day, the patient with a severe

From the D. . . . .



acid solution to be the most practical since it is most efficient in combating *B. Pyocyaneus* growth. However, a rare case of boric acid poisoning has been observed following prolonged use and this must be kept in mind constantly. As a substitute, sterile physiologic saline solution seems to be second choice.

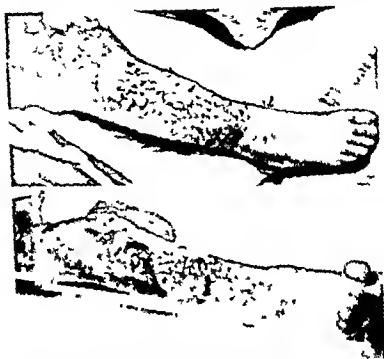
These wet dressings should be changed every one to two days until a firm red granulating bed is obtained. Any exuberant granulations can usually be flattened by the pressure dressing.

As soon as the bed is prepared, one should then proceed to cover the defect with a properly selected type of skin graft as described above. Whether local or general anesthesia is used for the operation should be decided by the same indications that govern the selection for other surgical operations.

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that the most careful aseptic technique be used to avoid the addition of infection. The patient, the surgeon and any assistants are dressed in sterile clothing. Sterile dressings are used throughout. The burned area



Figs 42 (Case I)—This patient (L. A.) was burned December 12, 1946 and transferred to the Children's Surgical Service March 12, 1947. The patient was in a critical condition—pale with pitting edema of scrotum and buttocks and a temperature of 104° F. Laboratory revealed hemoglobin of 7.5 gm., total protein of 4.7 gm. The original slough and eschar were still present (upper) and this was removed under light general anesthesia and in forty-eight hours appeared as shown (lower). This patient required eleven whole blood transfusions of 500 cc. each in eight days, to bring the blood levels to 12.8 gm. of hemoglobin and the patient's general condition was improved by losing eight months. The patient will require further care.

accurately determined and then the wound is redressed with dry fine mesh gauze next to the whole thickness skin loss and large pressure bandages over this.

There are several methods of removing the adherent deep burn slough of whole thickness skin burns. Regardless of which method may

whole thickness burn will exhibit a steadily progressive secondary anemia and loss of protein to dangerous edema levels unless corrected. If this nitrogen imbalance is allowed to continue unchecked, wound healing is interfered with and weight loss becomes extreme. If the blood values are found to be lowered, whole blood transfusions repeated as indicated are of great value, for they provide both the necessary hemoglobin and the proteins. The patient's progress must be constantly anticipated, checked and treated until the wound is closed by grafting.

#### LOCAL CARE AND TREATMENT OF THE BURNED AREA

At the Children's Service of Cook County Hospital the following plan of the management of the local burn injury has been followed. The objective has been to obtain closure of whole thickness burn loss within three weeks following the burn. To accomplish this end a definite plan of treatment must be set up and strictly followed—otherwise the care falls into a regimen of trial and error.

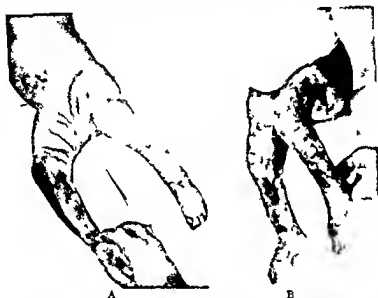
In the first place, we do not assume that we can judge the depth of the burn at the time of admission or the initial local care of the

depth of a burn is made in retrospect. For this reason the dressing which was applied at the time of the initial local care of the burn is not disturbed for ten days, unless there are definite signs of infection.

ten days has been taken as the time for the initial dressing for the following reasons. First, because it has been possible to have the patient's general condition well stabilized by this time. The patient's blood counts and protein levels are at a high normal after the changes following burn shock. Secondly, the ten day interval has been used, for at this time the demarcation between incomplete and whole thickness skin loss is very apparent. At this time incomplete whole thickness burns are either entirely healed or will be in another two to three days. The extent of the whole thickness burn areas can be readily determined, and if there is a defect measuring larger than a silver dollar we then proceed to get the wound closed as early as possible by methods that will be outlined later.

At the time of the first dressing on the tenth day, it is imperative

by fine mesh gauze fresh Dakin's solution and pressure dressing. This method is time-consuming it is painful to the patient and there is always the possibility of introducing infection to the raw open surface unless careful technique is followed. Certainly in most small circumscribed burns it is possible to obtain removal of the entire slough so that the grafting may be undertaken on the sixteenth to eighteenth



A

B

Fig 44 (Case III) - Three months old infant (I W) was seriously burned when her crib caught fire September 30, 1946. The immediate general care was difficult because of an associated tracheitis and bronchitis due to inhalation of fumes. The leg dressings were performed October 8 and pyruvic acid paste was applied to the right leg and thigh daily. The eschar completely separated after the third application of the paste on October 15 and grafting of the right extremity was performed October 16.

... .. exit and the blood levels were maintained at a high normal throughout.

day following the injury. The disadvantages are the danger of infection, the difficulty in removing the adherent slough and finally the factor of pain to the patient (Fig 43).

2. The second method for removal of the burn slough has been the application of pyruvic acid in starch paste. This method too has proved to be efficient for rather circumscribed types of burns. Where the pyruvic acid paste is to be used it is applied on the tenth day and

be chosen it should be the objective to accomplish the skin grafting during the third week or from the fourteenth to the twenty first day following the injury. To obtain this objective a planned attack is necessary. Too often surgeons have been negligent in waiting for spontaneous epithelialization of these wounds during which time the patient's general condition deteriorates. To delay closure of these wounds means a greater risk to the patient of incurring a superimposed infection with continued protein loss and severe secondary anemia and

### METHODS OF REMOVING THE BURN SLOUGH

1. The burn slough can be removed by daily dressing. This method is most suitable in cases of burns with localized and rather superficial



cial type of whole thickness burn loss where there is very adherent slough. It is an excellent method for burns of the



FIG. 1. (A) (B) (C) before and after treatment.

Direct skin grafting of chest and abdomen was performed on March 23. The patient's condition at the time of the initial postoperative dressing March 23 is shown in C. The patient required two additional small skin grafts to cover the remaining scattered unhealed areas completely. During the period of treatment she was given a total of six whole blood transfusions to maintain the blood levels at a satisfactory high normal level.

redressings are done every second day thereafter. The 1 per cent pyruvic acid paste is liberally applied, and at each succeeding dressing the burn slough is lifted off or parts of it are easily cut away. This method requires repeated dressings and therefore also carries the danger of the possibility of introducing a secondary infection. Further,

sensation. In areas where the third degree whole thickness slough is hard and boardlike and where it is firmly attached at the edges it has taken several days for the separation to be accomplished unless the slough is perforated by a scalpel to allow the pyruvic acid to come into contact with the slough and the healthy underlying tissue. This method has the advantage of quickly separating the more superficial types of full thickness loss and aside from the pain that may occur and the necessity for frequent dressings, it has been possible when using this method to have the areas prepared for grafting between the sixteenth and eighteenth day following the injury (Fig. 44).

3. The third method of treatment of the whole thickness burn loss is that of surgical excision. At the present time this is the method of choice in treatment of the serious burns. It has proven effective and has made it possible to have these seriously burned children grafted on the fourteenth to sixteenth day following injury. This method proved its worth in 1944 and 1945 in the Army in the Mediterranean

Where there is an area of whole thickness loss larger than two or three inches in diameter and where there is hard adherent black or

blood values be kept at a high normal level. Following excision the

burns are due to the attention directed to maintaining the general condition of the patient with minimum of trauma directed to the local wound and we should not lose this advantage by suddenly concentrating on the local wound as by surgical excision to the detriment or danger of the patient

#### SUMMARY

To obtain the best results for the seriously burned patient it is necessary for the surgeon to have a planned attack. This attack applies equally to treating the patient's general condition and the local wound.

It is imperative that the local burned slough be removed quickly to enable closure of the defect by grafting. The slough may be removed by (a) daily dressings for the thin adherent slough (b) pyruvic acid as a chemical debridement (c) surgical excision for thick hard adherent eschar.

It should be the objective to have these burned patients maintained in such good general condition that the slough can be removed and the wound closed at the latest by the twenty first day following injury.



The method of surgical excision is efficient in that the wound is dressed only once prior to grafting except at the time of the tenth day when the wound is first inspected and therefore there is a minimum of pain for the patient. Certainly it is the most surgical procedure of all three methods for converting these large open wounds into closed wounds at the same time as here the slough has been removed.

This procedure of surgical excision of the whole thickness burn slough is not of value in burns of the face or neck because of the normally rapid separation of the slough in these areas due perhaps to better blood supply. In any extensive burn there is some danger from the

very large. If in doubt as to the amount of blood that may be lost, the excision may then be done in "stages."

Since a delayed surgical excision has been advocated it would perhaps seem more logical to champion the cause of primary surgical excision of burns immediately upon their arrival at the hospital. However, this has not seemed to be a feasible procedure in our experience and especially in the treatment of burns of children. Frequently we have been misled in our interpretation of what constituted a whole thickness burn loss, except in very obvious cases where on admission the skin appeared hard, boardlike and anesthetic. In these instances where the depth in certain areas may be known the actual extent of this area has not been easy to determine for it is surrounded by an areola of tense reddened skin whose depth of involvement at the periphery has not been apparent. Again most children with burns of

on the shock of an extensive burn

Surgical excision of the burn slough has some limitation on the amount that may be excised at one sitting, or where there is excessive blood loss when the incorrect line of cleavage has been encountered. Finally, there are areas around the edges of the whole thickness loss which are not apparent as to their depth even on the tenth or eleventh day. Where there has been doubt at this time we have let the ques-  
attention to the obvious full

from the fourth to the sixth day following injury these small patients would not be satisfactorily stabilized to withstand the added trauma of the operative procedure and blood loss. Most worthwhile advances made in the treatment of

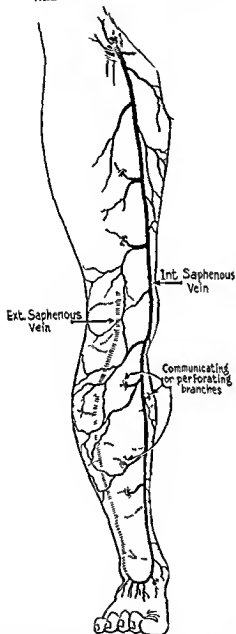


Fig 46—The saphenous system of vein is 'J' shaped with the long arm, the internal saphenous vein, entering the deep vein at the fossa ovalis and the short arm, the external saphenous vein, joining the deep vein in the popliteal space. Numerous communicating or perforating branches in the thigh and calf connect the superficial with the deep veins.

## VARICOSE VEINS AND ULCERS

FRANK V THEIS M D, F A C S \*

VARICOSE or dilated veins of the lower extremities are a common cause of disability and have been an important surgical problem since the earliest period of recorded medical history.<sup>15</sup> Various forms of treatment have been used, discarded and revived, with modifications. McPheeter's recent report<sup>16</sup> on his observations in the large medical centers of the United States disclosed a wide divergence of opinion on methods of treating varicose veins. Various surgical procedures<sup>16</sup> are being used with successful and satisfactory results and many failures. Many patients treated today have had some previous surgical procedure for varicose veins. As a rule, some benefit had been derived from the operation but further treatment is frequently necessary. The magnitude and hazards of certain operations, the period of prolonged disability and the probability of recurrences, deter one from recommending a second or third operation. The injection treatment seemed to offer the best results, especially when considering the relative simplicity and safety of the treatment and the lack of disability of the patient.

For some years the pendulum swung widely in favor of the injection treatment. Objection to the procedure soon arose, owing to the large number of injections required over a period of months and to the number of recurrences. Because of this, many surgeons discredited the new procedure and are still adhering to the old radical operations. On the other hand, a number of European surgeons, instead of discarding the injections combined the less radical surgical procedure—ligation of the internal saphenous vein—with the injections. De Takats<sup>7</sup> (1930) was the first surgeon in this country to report on his experience with the combined method. Since then modifications of the technic have greatly improved the results and have overcome most of the objections. Further advances are needed in the development of better sclerosing solutions, in the selection of cases for ligation or for injection, and in recognizing the limitations of what is to be accomplished by treatment.

### NORMAL ANATOMY OF VEINS OF LOWER EXTREMITIES

The veins of the lower extremity comprise the surface or saphenous system located in the superficial fascia and the deep system located

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the medial and lateral superficial femoral branches from the proximal internal saphenous form a complete anastomotic network encircling the extremity. When considering the results of treatment of varicose veins it should be remembered that only a part of this venous network is occluded or removed; the cause of the original varicosities may still be present and may continue to produce dilatation of the remaining veins.

Valves are present in the superficial and deep veins as well as the

small flimsy bicuspid valves in each saphenous vein and one pair in each perforating branch. As a rule a valve is present in the principal vein just distal to an entering branch.<sup>17</sup> Knowledge of their presence and location is necessary for interpreting the results of various tests for varicose veins. With the combined method of treatment competent valves will prevent the introduction of a cannula catheter or instrument or the retrograde injection of the sclerosing solution.

The proximal internal saphenous vein and the five superficial branches—circumflex iliac, epigastric, external pudendal and the lateral and medial femoral—are subject to considerable variation (Fig. 47).

ovalis is  $1\frac{1}{2}$  inches lateral to the pubic tubercle and  $1\frac{1}{4}$  inches distal to the inguinal ligament (the inguinal crease is 1 inch distal to the ligament). The superficial branches usually join the saphenous just distal to the saphenofemoral junction but two or three branches may unite to form a common entering branch. Excellent descriptions and illustrations of these anatomical variations<sup>2, 10, 22</sup> have appeared in the literature and should be familiar to surgeons performing high saphenous ligations.

### **PATHOLOGY OF VARICOSE VEINS**

Varicose veins occur in the superficial veins of the lower extremities in two forms: primary and secondary.

1. The *primary form* due to gradual stretching or dilatation of the veins as a result of increased venous pressure<sup>1</sup> or structural weakness of the vein wall produces a relative incompetency of the valves. As the vein dilates the valve leaflets are stretched and the valve becomes incompetent. The vessel so dilated with two valve leaflets dilatation of 0.4 to 1.0 times the diameter of the vein will produce incompetent valves. After a period of rest in bed dilated and incompetent veins may regain their tone but sooner or later on

within the muscles and muscle aponeurosis. The saphenous system is "J" shaped with the long arm the internal saphenous vein coursing from the foot along the inner aspect of the extremity to join the femoral or deep vein at the fossa ovalis in the groin and the short

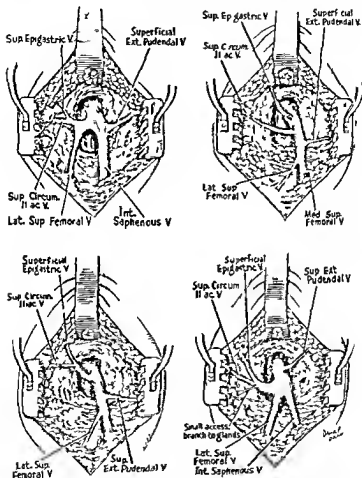


Fig 47—The most frequent anatomic arrangements of the saphenofemoral junction and the superficial branches at the fossa ovalis

from the external saphenous passing along the outer and posterior

46) Numerous superficial veins  
saphenous veins with

endothelial irritation to cause intravascular clotting. Because considerable experience is needed to interpret the roentgenograms the information obtained is not sufficiently reliable or necessary for diagnosis to warrant the expense and danger involved in its routine use.

**Diagnostic Tests**—For practical purposes the results of the following tests provide information of value in the diagnosis of varicose veins and in the selection of patients for treatment by various procedures.

1 **Detection of varicose veins** The palpating fingers can usually follow the course of dilated veins which are obscured in the subcutaneous fat. The soft compressible groove of a thin walled dilated vein or the firm cord of a fibrosed vein may be readily detected by this means.

2 To determine the patency of the deep veins *elastic support test*. Relief from subjective symptoms and absence of discomfort when wearing properly fitting elastic stockings or bandage assures the presence of adequate deep circulatory channels.

3 To determine the competency of the valves in the superficial veins *percussion stroke*<sup>21</sup> or *ballotement test*. With the patient standing, segments of varicose veins may be neither visible nor palpable. Sharp tapping of the fingers of one hand on a dilated segment will cause an impulse to be transmitted proximally through the blood filled vein to the palpating fingers of the other hand placed along the expected course of the vein. If the impulse is transmitted

pulse is not of pathologic significance however since this is the normal direction of blood flow.

Incompetency of the valves of the internal saphenous is detected by tapping over the fossa ovalis and the impulse palpated along the reverse flow of blood in the distal course of the vein. With competent valves the impulse will not be transmitted beyond the next valve. Segmental use of this test is of value in detecting incompetency of individual valves. In my experience this has been the simplest and most valuable test to determine the competency of the valves in the superficial veins.

4 To determine the competency of the valves in the perforating or communicating branches and the superficial saphenous veins.

(a) *The tourniquet test*. With a tourniquet placed high on the thigh the patient actively walks or jumps up and down on his toes at least ten times. Contraction of the leg muscles empties the surface veins by suction of the blood into the deep veins. Incompetent valves in the communicating veins permit reverse flow of blood from the deep veins and rapid (within 30 seconds) refilling of the surface veins (Fig. 48). When incompetent valves are present in the superficial veins removal of the tourniquet is followed by immediate re

resuming the upright position the dilatation will recur resulting in eventual permanent changes in the wall. As the scar tissue which replaces the muscle and elastic tissue stretches the veins widen and lengthen, causing irregular tortuosities and sacculations. Occasionally calcification occurs in the scar tissue.

2 The *secondary form* due to thickening of the vein and fixation or contraction of the valve follows thrombophlebitis and organization of the thrombus. Ordinarily dilatation does not occur because of the fibrosis but the damaged valves permit stagnation and reverse flow of blood which results in malnutrition of the tissue. These veins may be palpated as firm cords or contracted vessels. The incompetent fibrosed

by chronic malnutrition and edema. The absence of prominent veins obscures the cause of these changes in the superficial tissue. The malnutrition is attributed to the increase in carbon dioxide and decrease in oxygen in the stagnant venous blood\* and to the increased protein content of the edematous fluid. The high protein content of the lymphedema stimulates excessive fibrosis. This may remain stationary for years or may become infected and ulcerate.

### SYMPTOMS AND DIAGNOSIS

The presence of varices  
varicosities may be obscure  
and subcutaneous tissues

the size of the veins. Minimal local varices may be associated with aches, heaviness of the limb, pains, swelling, eczema and recurrent thrombophlebitis while large and extensively involved veins may be

\* When varices  
blue saccula-  
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t

usually be  
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Venography of the  
superficial venous channels and locating obstruction in the deep veins.  
In some cases the 35 per cent diodrast solution has produced sufficient

filling of the surface veins By reapplying the tourniquet at various places on the thigh the levels of the reverse flow from incompetent perforating branches can be localized

Another method of using the tourniquet test is to elevate the limb each time before applying the constriction at various levels By lowering the limb rapid refilling of the surface veins below the tourniquet denotes incompetent valves in the communicating veins Failure of complete refilling of the veins until the tourniquet is removed indicates that the valves in the superficial veins are incompetent

(b) *Trendelenburg test* With the extremity elevated digital pressure is applied over the saphenous vein and the limb is lowered to observe the incompetent valves. The test is performed as with the

tourniquet test but the extensive collateral venous channels encircling the upper thigh may contribute to refilling the distal veins independent of an incompetent internal saphenous vein This test is of much less value in determining the competency of the valves than is the tourniquet test

(c) Other tests for determining the presence of incompetent valves in the communicating veins Various modifications of the tourniquet and Trendelenburg tests contribute little information which is not otherwise obtainable Incompetent communicating veins or "blow outs" can be detected by the palpating finger as a localized depression or hole in the subcutaneous tissue Pratt's test<sup>10</sup> localizes these points between two tourniquets

### TREATMENT

Any procedure that safely removes the dilated incompetent superficial venous channel must be of some benefit to the patient The success of treatment will depend upon the selection of the proper procedure for the particular case to be treated and the experience skill and judgment of the surgeon<sup>12</sup>

**Conservative Treatment**—Conservative treatment is indicated when surgical or injection procedures are not advisable The presence of acute or chronic infection recent thrombophlebitis of the deep

calculus  
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Any ser

burg double positive with incompetent valves and reverse flow of blood in both the internal saphenous and communicating veins.

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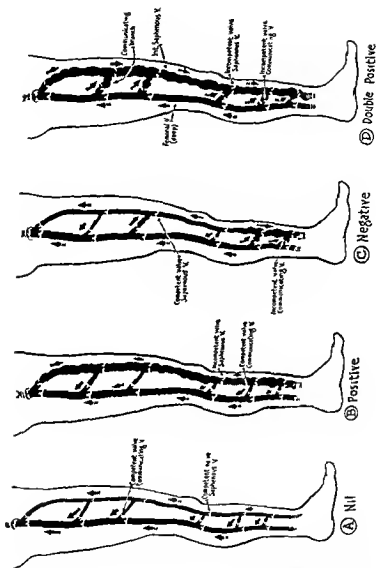


Fig. 48—Interpretation of the results of the tourniquet or Trendelenburg tests

Trendelenburg negative with incompetent valves and reverse flow of blood in the communicating veins and normal valves in the internal saphenous *D* Trendelen

Induration, discoloration, eczema or ulcerations of the leg respond satisfactorily to properly applied pressure.<sup>27</sup> For ulcers, the use of an Unna's paste boot for the usual period of a few days to a few weeks

vent sticking, has proved very satisfactory when applied daily to the ulceration by means of a firm bandage. This is similar to a McPheeter's sponge pressure. Infection of the ulcerated area is treated with hypertonic (25 per cent) magnesium sulfate solution dressings, these are applied for a few days until the infection subsides. It is

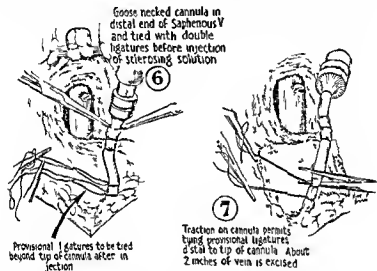


Fig. 49—Operative procedure in combined saphenofemoral ligation and distal injection for obliteration of incompetent internal saphenous vein

wise to delay operative procedures or injection of the veins until the infection, ulceration, induration and edema have been treated for at least six weeks. The fact that the lymphatic vessels draining these areas are located in the adventitia of the veins is an important etiologic factor in the development of severe inflammatory reaction along the course of the injected or ligated vein. A few weeks delay in the obliteration of the varicose veins is little inconvenience compared to the inconvenience and suffering caused by severe periphlebitis occurring when the veins are hastily treated.

**Surgical Treatment**—Surgical treatment is indicated for varicosities of the internal saphenous vein when diagnostic tests have demonstrated incompetency of the valves and there is no contraindication to surgery. Experience has definitely established that the combined

pectancy obviously calls for conservative treatment. Conservative treatment is advisable during the last six months of pregnancy and the first three months of the postpartum period

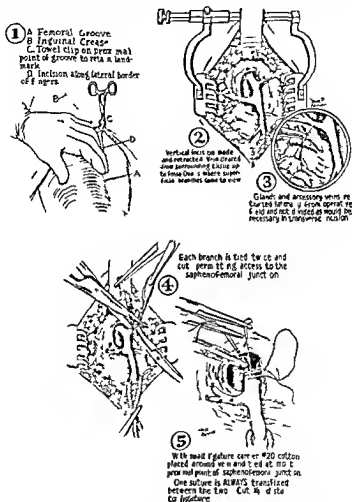


Fig 49 (Continued on next page)

When temporary relief from varicose veins or complications is required, elastic support to the leg from the instep to the knee with an elastic woven or web bandage will give considerable palliation. The support should be maintained when the patient is ambulatory and may be removed when the patient is lying down.

danger and is difficult to control. A stump of about  $\frac{1}{4}$  inch is left distal to the ligature and this retracts into the fossa ovalis as the saphenous is cut.

The distal end of the saphenous vein is now cannulated with a goose-necked cannula and the vein is tied tightly around it with two ligatures. Normal salt solution is injected to determine whether the contraction of the vein resulting from the manipulation has restored the competency of the valves and to detect any leakage from the vein or cannula. This is preliminary to the injection of 2 to 4 cc. of 5 per cent sylnasol solution and the most distal point of the vein is doubly

are encountered they are treated similar to the distal saphenous vein. The fascial sheaths surrounding the bed of the saphenous vein are closed with purse-string sutures and the subcutaneous tissue and skin are approximated with interrupted cotton sutures.

For the low thigh ligation of the internal saphenous vein (below the most distal incompetent perforating branch) or for ligation of the perforating branches 1 inch skin incisions give adequate exposure. These sites are previously marked by means of scratches. When sclerosing solution from the high injection is seen in the distal veins further injection is not necessary; otherwise from 0.5 to 1 cc. is injected distally at each site. After the vein has been exposed and cleared 1 inch segments are excised between double cotton ligatures.

**Injection Treatment of Varicose Veins**—The primary object of the injection of chemical irritants for the obliteration of varicose veins is to destroy the entire endothelium of the intima.<sup>3, 35</sup> With the patient ambulatory the active circulation of blood through the vessel produces a deposition or mixed thrombus on the damaged intima which gradually occludes the vessels. Secondary coagulation thrombosis can be reduced by having the patient remain ambulatory<sup>40</sup> for at least six hours after injection. The firmly attached thrombus undergoes organization and contraction and if the intima has been damaged around its entire circumference no endothelium will remain for proliferation and reestablishment of the lumen. A permanent obliteration will result. On the other hand, intact endothelium will proliferate and cause partial restoration of the lumen. Reopening of the lumen will result. This has been described previously and is the basis for recurrence of varices following any type of thrombophlebitis.<sup>36</sup>

**Solutions for Injections**—The ideal solution for the injection is still to be found. Although the sodium salts of cod liver oil (sodium morrhuate) or of psyllium seeds (sylnasol) in 5 per cent solutions give the most satisfactory results the rare occurrence of systemic reactions is an objection to their use. Hypertonic glucose, dextrose, invert sugar, sodium chloride, sodium salicylate and quinine and urethane so-

saphenofemoral ligation and simultaneous distal injection (Fig. 49) has given most uniformly satisfactory results.<sup>7 14 23 24</sup>

**COMBINED SAPHENOFEMORAL LIGATION AND DISTAL INJECTION—Landmarks**—The most reliable method for locating the proximal internal saphenous vein and fossa ovalis at operation is to palpate the femoral canal just lateral to the adductor longus muscle. The tips of three fingers can be placed in the groove and the saphenofemoral junction is located along the lateral border. The fossa ovalis is about  $\frac{1}{2}$  inch distal to the inguinal crease or about  $1\frac{1}{2}$  inches distal to the inguinal ligament. The vein can also be located about  $1\frac{1}{2}$  inches lateral to the pubic tubercle and  $1\frac{1}{2}$  inches distal to the inguinal ligament. In obese individuals landmarks may be indefinite and then a point about  $\frac{1}{2}$  inch medial to the pulsating femoral artery can be used.

**Anesthesia**—Block anesthesia is produced in a 3-inch diamond shaped area of skin and subcutaneous tissue. About 40 cc. of 1 per cent procaine solution is routinely used. Since the immediate post operative course requires that the patient be ambulatory,<sup>21 22</sup> general anesthesia should not be used. Intravenous injection of the anesthetic solution must be avoided. As the operation proceeds injections are made in the deeper layer.

For the low ligations about 5 cc. of the novocaine solution is infiltrated around the site of the incision.

**Incision**—Both the transverse and vertical incision have been used, actually, the same exposure is produced when the incisions are retracted. However, in deepening the transverse incision through the

down on a segment of the proximal internal saphenous vein the glands with their accompanying bleeders are displaced laterally and are not disturbed. By retracting the upper angle of the wound the saphenofemoral junction and the three superficial branches are brought into view.

**Technic of Operation**—The proximal internal saphenous vein is exposed for about 3 inches and the fossa ovalis is cleared along with

ligature is transfixed. *Dissection, 10*  
when a ligature which has not been transfixed has slipped off, is a real

lessen the discomfort from periphelebitic reaction and will hasten convalescence

Subsequent injections are given at monthly periods. These will permit the patient to return to his usual work. If an ambitious treatment is given, the patient will experience discomfort and inability to work for the safety and permanence of the obliterative process.

**Treatment of Varicose Ulcers.—Skin Grafting for Ulcers—No**

quicker healing and better

taneous healing. A short period of treatment of the ulcer with moist saline dressings will provide relatively sterile granulations for primary takes of skin grafts.

**Excision of Ulcers**—To hasten relief from pain, convalescence and recovery excision of ulcers with primary or secondary skin grafts is being performed by some surgeons. This is a radical procedure, for most of the ulcers heal promptly following properly applied pressure dressings. The obliteration of varices or perforating branches either by ligation or injections will frequently produce rapid and permanent healing of the ulcer. *My observations have not been favorable to excision and skin grafting.*

**Proximal High Ligation for Ulcers and Long standing Deep Phlebitis**—Coller and his associates<sup>4</sup> have reported their experiences with ligation of the femoral or iliac veins or the vena cava for these complications. As yet, their observations and results do not warrant the acceptance of the procedure.

## COMPLICATIONS AND SEQUELAE

**From Varicose Veins**—Varicose veins are frequently associated with disabling complications and sequelae out of proportion to the size and extent of the veins. The high protein content of the edematous fluid stimulates excessive fibrosis and leathery thickening of the

matory reaction is uncertain. The serum protein level<sup>5</sup> of patients with marked skin and subcutaneous fibrosis is not altered and the effect of protein therapy on the ulcer is questionable.

Varicose ulcers usually "ride" on the cutaneous site of a varicose vein<sup>6</sup> or an incompetent perforating branch<sup>7</sup> in the lower leg. The depth of the ulcer may be due to edema and fibrosis. Removal of this edema and fibrosis by properly applied pressure produces rapid relief from pain and spontaneous healing. The "ulcerating phlebitis" (Ed-

dium morrhuate, sodium salts of some of the fatty acids of psyllium seeds (sylnasol), sodium linoleate, sodium ricinoleate, sodium oleate and many other solutions have been used but there are objections to all of them. Franklin<sup>12</sup> states that the ideal solution must be "sterile antiseptic or bactericidal, nontoxic, easy to manipulate and not corrosive to tissues around the vein though it is to the venous endothelium. The substance to be dissolved should be pure, of unvarying standard, and of such nature that idiosyncrasy to it is unknown. The amount needed to be injected should be small, the solution easy to

that are being used

So far, 5 per cent sodium morrhuate and sylnasol are the most satisfactory solutions. However, the sodium morrhuate solution is of varying purity,<sup>23</sup> for severe reactions have occurred with some preparations and rarely with others. The reactions which will be described later occur far less frequently with the psyllium preparation. This is

solution is more certain to be diluted with blood and less likely to produce adequate irritation of the intima. Rapid dilution and dispersion of the injected solution by the blood as it is carried away prevents destruction of the intima of the deep veins.<sup>23</sup> When large quantities (20 to 30 cc. or more) of concentrated solutions (10 per cent) are used the irritating effect has extended to the deep veins with resulting thrombosis.

Digital pressure for two or three minutes will delay the injected solution from being washed away by returning flow of blood. From four to ten sites are injected with 2 to 5 cc. of the 5 per cent sylnasol. The more areas than can be injected along will be the intimal damage.

bandages to the limb for a swelling has disappeared will and the amount of postinjection. The bandages are removed

tion With competently performed saphenofemoral ligation and simultaneous injection of the varices very satisfactory results are obtained

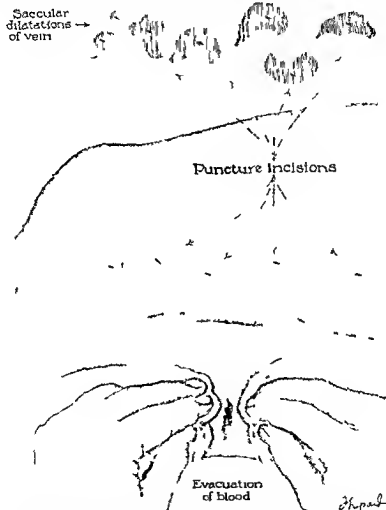


Fig 50 Puncture evacuation of blood filled saccular dilatations with intervening areas of thrombotic occluded veins From ten to fourteen days after injections a fine tenotome (about the size of an 18 gauge needle) is used to puncture the sacculations and evacuate the semiliquid contents

Postoperative or postinjection inflammatory reaction has not been serious or dangerous and actually assures more permanent obliteration



wards) is the result of a phlebotic vein adherent to the skin and ulcerating. These ulcers, around the ankle or foot, are particularly painful because of the nonyielding character of the tissues. Their location makes pressure dressings difficult to apply.

**From Ligations.**—Ligations of varicose veins incur hazards pro-

when a thin walled saphenofemoral junction is ligated. Reports of such ligations are in control to the distal end of the saphenous may slip off either at the time of operation or during the postoperative ambulatory period. I observed this in one case. The vascular reaction was difficult to control. The convalescence was prolonged for weeks. One of the two ligatures applied to the larger blood vessels should be transfixed.

Infection has not been a serious complication. One report of a fatal case of suppurative thrombophlebitis has been published in the literature.<sup>7</sup> Owing to the fact that lymphatic channels in the lower extremities are located in the adventitia of the veins, latent or "resting infection" may be present and any trauma to the vein may be followed by variable amount of inflammatory reaction. A severe thrombophlebotic reaction of the entire internal saphenous vein may follow a very simple and competently performed ligation. The degree of inflammatory reaction seems to depend upon the amount of lymphatic absorption from the peripheral tissue reaction. For this reason operative and injection treatment should be delayed for sufficient time to assure minimum latent infection in the lymphatic vessels.<sup>41</sup>

Peripheral edema is a common occurrence following ligation and injections and is proportional to the postoperative thrombophlebotic reaction and the extent of the venous occlusion. Marked relief follows the application of elastic support to the leg. Large distended partially obliterated sacculations along the course of the veins can be emptied of the semifluid contents by puncture evacuation (Fig. 50) with resulting rapid improvement in the thrombophlebotic edema.

Recurrence of varicose veins is largely proportional to the adequacy of the surgical procedure and of the injections. The pathologic process responsible for the original occurrence of varicose veins may still be present, only a limited extent of the varices are removed by operation and the remaining veins may undergo compensatory dilata-

piration rapid and shallow and a drop in blood pressure occurs. Prompt treatment with epinephrine (10 minims), using repeated doses if necessary, oxygen inhalations and intravenous salt solution produce rapid response and complete recovery. *Further injections of any fatty acid solution must be avoided permanently.*

Necrosis of the perivascular tissues is the result of perivascular injection of the sclerosing solution. *Great care must be exercised to assure injection within the veins, to avoid leakage and to dilute the perivascularly injected solution by adequate injection of normal salt solution into the surrounding tissues.*

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**From Injections**—Thrombophlebitis is the primary object of the injection treatment. The inflammatory reaction and thrombus formation will contribute to the permanent obliteration of the vessel. The reaction is expected and may increase in severity from three to five days and when severe subsides by the fifth to the seventh day.

Secondary propagating thrombus formation and embolism is a theoretical rather than an actual danger.<sup>21 27 32 40</sup> Ambulatory convalescence promotes a solid thrombus firmly attached to the intima with a minimum danger of extension to the larger veins. Confinement to bed which may become necessary for some other reason has accounted for all the rare cases of postinjection embolism with which I am familiar.<sup>36</sup> Homans reported three deaths from pulmonary embolism following saphenous ligation occurred after postoperative confinement to bed. Immediate ambulation following ligation is possible when local anesthesia is used.

Reactions from sclerosing solutions are a troublesome although in common complication. Hypertonic sodium chloride or sodium salicylate frequently produces painful local or systemic vascular spasms. The sugar solutions do not produce deleterious effects. Idiosyncrasy to quinine in the quinine and urethane solution has been troublesome. The most satisfactory solutions for their sclerosing effect are the sodium salts of certain fatty acids but the rare occurrence of sensitization to the drugs<sup>9</sup> and anaphylactic reaction is an objection to their

5 per cent of the cases and is usually of no importance and (2) systemic anaphylactic reaction occurs in less than 0.5 per cent of the cases and may be serious. It has been reported to have produced death. Lewis<sup>2</sup> and Zimmerman<sup>42</sup> attribute the systemic reaction to some protein liver radical in the morhuate solution but identical reactions occur in the same individual with sodium linoleate or oleate solutions or with the psyllium preparation which is evidence against the liver protein radical as the responsible agent. Scratch or intradermal skin tests are of no value in detecting and excluding these cases.

Anaphylactic reactions<sup>30 33 39</sup> are serious complications and may

Etiology and Pathology of Emboli Zentral f Chir., 58 1149-1510 (June 13) 1931

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differential diagnosis of cause of a sudden arterial occlusion is encountered in patients with extensive arteriosclerotic ulcer or just as likely may be due to spontaneous arterial thrombosis in a region severely involved with the degenerative disease

A lodged embolus produces its damage through several mechanisms. The major channel involved is mechanically obstructed by the mass of the embolus. The ...

The stages of treatment we employ in embolism are designed to combat the various mechanisms of injury. Upon diagnosis of embolism, the patient is given a dose of 100 to 150 mg. of sodium nitroprusside. This is continued about in completely recovered cases or until amputation is done in less favorable cases. Paravertebral novocain block of the lumbar or dorsal sympathetic ganglia is accomplished as soon as possible. A marked improvement of the signs of arterial insufficiency routinely follows the block, particularly the line of skin cooling has receded in our cases and a diminution in pain has been noted.

At this point in the treatment the question of whether embolectomy should be done is considered. Since it is unlikely that much arteriospasm is present after paravertebral block, the degree of ischemia now present represents the anatomical obstruction produced by the embolus and secondary thrombosis formed above and below it. In young persons, the vessel in a location of often a complete disappearance of arterial interruption usually persist in such a patient to the extent that there is some comparative coolness of the involved extremity and the pulses are still absent. Under these circumstances embolectomy has ordinarily not been done. Rather it can be expected that with supportive measures the collateral circulation will develop and prevent all sequelae of the obstruction.

Any less favorable response to the block is immediately followed by surgical intervention. Embolectomy is performed in many cases in which medical management undoubtedly would result in prevention of gangrene, but it is felt that removal of the obstruction will prevent the less dramatic but very disturbing other late symptoms of arterial insufficiency.

*Embolectomy*—Observation of the level of skin cooling, the position of the demarcation between skin of normal and cyanotic color and the level to which peripheral pulses are absent enables one to determine the level at which the embolus has lodged. The line of rapid gradient of fall in skin temperature has been dependably found

## PERIPHERAL ARTERIAL OBSTRUCTION

ORMAND C JULIAN, M D, PH D, F A C S \*

TREATMENT in peripheral vascular disease has in recent years improved rapidly through the application of new techniques and new drugs of special purpose. The fundamental physiologic concept of applying cold rather than heat to a part deficient in arterial circulation and a better and better understanding of the use of anticoagulants in both arterial surgery and spontaneous conditions of intravascular clotting have improved results remarkably.

The peripheral vascular conditions producing arterial obstruction are best considered by dividing in groups those diseases which produce arterial insufficiency gradually or suddenly, and structural vascular changes including aneurysm and arteriovenous fistula.

### ACUTE ARTERIAL INSUFFICIENCY

Acute arterial insufficiency is produced by arterial embolism, trauma and arterial thrombosis. The clinical picture produced is much the same whatever the cause. Early symptoms of shooting pain, cooling of the extremity, and gradually increasing numbness are followed very quickly by severe continuous pain, numbness and inability to move the extremity. Objective findings are coldness and mottled cyanosis of the skin, collapse of the superficial veins and loss of the peripheral pulses.

**Embolism**—Embolism of a major or middle sized artery of an extremity is indicated when this complex of symptoms and findings is present. The emboli are usually mural thrombi forming over ulcerated atherosclerotic plaques.

A fairly dependable diagnosis of the source of an embolus can be made in the presence of continued auricular fibrillation. A history of a recent myocardial infarct makes the diagnosis elementary since embolism in this condition ordinarily occurs while the patient is still under active medical treatment for his infarction. More difficulty in

It is uncertain in this case whether the distinct change in findings resulted from a downward move of the embolus or in the relief of spasm which permitted the character and location of the true obstruction to be diagnosed. There is good reason to believe that if the embolus had not been removed in this case, conservative treatment would have succeeded in saving the foot from necrosis. However the late sequelae would have included some symptoms of arterial insufficiency such as plantar claudication. Embolectomy in this case and in the majority of other instances can be done under local anesthesia and it is a minor operative procedure which is taken very well in all but the most ill patients. Successful embolectomy provides for complete freedom from all sequelae of the arterial occlusion.

The surgical principles involved and the technic used in embolectomy differ little wherever the site of obstruction may be. An incision made over and parallel to the artery is developed by careful dissection downward to expose a generous segment of the vessel above and below the obstruction. Proximal and distal control is obtained by looping a narrow cotton tape about the vessel at each location. This is held firmly in place by a hemostat placed on the tape. Placement of the distal tape first offers security from downward passage of the embolus. The smooth end of a glass suction tip is passed into the vessel through a longitudinal incision cleanly made through all its coats. The embolus is ordinarily easily drawn out as the suction holds it fast to the tube. Clots are sucked out from below by passing the suction through the relaxed distal tape and then clots are washed out from above by momentarily relaxing the proximal tape. The incision in the vessel is closed by a single layer of over and over suture of 6-0 black silk on anatra mat needle. It is then released by

oozing out  
pressure with

and usually produces a dry closure. Persistent leaks must be closed with individual horizontal mattress sutures. Closure is made without drainage.

The exposure of emboli is in most locations immediately evident from the anatomy concerned. In the case of popliteal emboli and the aortic bifurcation some special considerations are necessary. Exposure of the popliteal artery is made by an incision in the popliteal space through the deep fascia and between the heads of the gastrocnemius to expose the vessels. Commonly the embolus will lodge at the bifurcation into anterior and posterior tibial vessels which is in the middle portion of this exposure. In the less common instance of an embolus lodging higher in the popliteal space the vessel opening may be made within the limits of

the popliteal space. The incision is developed through the deep fascia and between the heads of the gastrocnemius to expose the vessels. Commonly the embolus will lodge at the bifurcation into anterior and posterior tibial vessels which is in the middle portion of this exposure. In the less common instance of an embolus lodging higher in the popliteal space the vessel opening may be made within the limits of



to indicate embolization at the major bifurcation just central to it. In utilizing the presence of peripheral pulses in determining the level of the embolus it must be remembered that the clot itself may transmit the pulse wave from the free lumen above it.

On the basis of the cardiac history and the findings a diagnosis of embolization of the right popliteal artery was made and a primary dose of 100 mg of heparin was given. A right lumbar sympathetic block was done and after the block the

was exposed and found to be the site of a firm embolus. This was removed and repair of the artery accomplished. The color and temperature of the leg returned to normal after first passing through a period of intense hyperemia.

In this case consideration of all the available signs of localization including oscillometric readings prevented surgical attack at the wrong level.

digitalization

was made. At 10:00 P.M. an incision was made, incision was made. Following the removal of the embolus the opening in the

artery was repaired with PDS suture. The patient made an uneventful recovery from the operation and was returned to the medical ward for further treatment of his cardiac condition.

need to stay bleeding can lead to ill considered blind clamping of hemostats into a poorly exposed field. Additional trauma to the injured vessel and damage to vessels and nerves not previously involved occurs.

CASE IV—G. H., a 23 year old white man, was admitted to Hines Hospital on October 4, 1946. Five days before admission he had incurred a stab wound in the upper anterior aspect of the left thigh. Severe bleeding was controlled by application of



Fig. 51 (Case III) —Illustrating the mottled cyanotic appearance of the left forearm and hand in embolus of the brachial artery.

a tourniquet high in the groin. In the interval between injury and admission to the Veterans' hospital treatment had been given. The tourniquet was removed by the hospital staff and a petri dish was placed over the wound.

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the same incision and the embolus brought downward from its proximal position with suction

The bifurcation of the aorta may be exposed most easily through

the peritoneum is stripped from the lateral and posterior abdominal wall. In patients whose condition will not permit a major procedure, it is worth while to attempt aspiration from below through the femoral artery on one or both sides.

It is said that embolectomy may successfully be done up to ten hours after its occurrence. It is likely that this period can be prolonged when necessary by the use of anticoagulants and sympathetic novocain block. In the presence of widespread arterial disease where in travascular clotting is a particular danger the operation should be done without delay. In the following case the removal of the clot was completed within an hour of occurrence and despite widespread arteriosclerosis recovery has been complete.

**CASE III**—On previous admissions R.S., a 46 year old white man, had been subjected to amputation of gangrenous toes of the left foot and amputation of the right leg. Tissue diagnosis was arteriosclerosis. Healing of the left foot occurred

midarm level

temperature immediately improved but the radial pulse was not coming. Fearing that a smaller portion of the embolus had traveled on to the bifurcation

have been no sequelae

The unusual importance of removal of the embolus in this case comes from the fact that many of the major vessels of the arm had already been rendered useless by the degenerative vascular disease.

**Traumatic Interruption of Arterial Trunks.**—The principles involved in the management of traumatic interruption of arterial trunks are much the same as those considered in embolism with the added complication of hemorrhage. In trauma to major trunks the obvious

of survival of the relatively ischemic extremity. Such a degree of refrigeration is readily obtained by simple use of a rubberized sheet (Fig 52). The sheet is folded in half transversely and placed under the arm or leg with the folded edge toward shoulder or hip. The edges of the sheet are fastened to a metal cradle placed over the extremity.

with ice. Pressure from the weight of the ice should be looked for over the malleoli and the femoral condyles and relieved by light accessory padding. A skin temperature of 50° to 60° F may be main



Fig 52—Mild refrigeration of an extremity obtained by placing ice between the layers of a doubled rubber sheet. Water drainage is over the foot of the bed to the floor basin. The skin temperature is controlled by the number of layers of orthopedic sheet wadding applied to the extremity.

tained with this technique. Gradual termination of the refrigeration can be done by increasing the amount of wrapping about the extremity over a period of one to three days.

Arterial Thrombosis  
as a major factor

one or both lower

extremities in a previously slowly progressive arteriosclerosis.

The management of such a thrombosis is concerned with the use of anticoagulants to stop the progress of the intra arterial clotting measures to abolish vascular spasm, chemotherapy particularly in cases of arterial thrombosis due to trauma and refrigeration.

groin was explored. The femoral vessels were examined after adequate exposure. It was found that the superficial femoral vein and artery had been transected by the injury about 1 inch below the profunda branches but that the common femoral artery had been crushed by the hemostat which was still in place. The clamped vessels were ligated and an open guillotine amputation of the leg was immediately done at the line of skin demarcation. Revision of the stump was necessary after four months. The patient had subsequently been fitted with a satisfactory prosthesis.

Proper management of such a perforating wound involves tourniquet or manual pressure to stop bleeding followed by exploration of the wound. Replacement of blood loss should be given a good start while the area of the wound is prepared for operation. With a minimum of trauma to the collateral circulation, the injured vessel is exposed proximal and distal to the wound and secured with cotton tape. The tourniquet is released at this stage and general hemostasis is accomplished. Finally the vessel wound is exposed and examined in a dry field. Most perforating wounds of vessels will be found to be incomplete rather than complete transections of the vessel. These should be closed if their edges are sharp. One or two interrupted sutures may be placed to be sure of proper edge placement. A continuous suture of the same material will complete the repair. To close a more or less longitudinal vessel tear transversely for the theoretical advan-

ter degree center of ven lost or and repair must be transverse. The loss of a significant portion of the vessel circumference makes necessary a complete resection at right angles of the damaged vessel. The form of surgical management the damaged vessel and surrounding tissue

and evacuation of pressure-producing hematoma have given a high proportion of good results.

The management following ligation should include anticoagulant therapy to diminish the danger of clotting in the distal portion of the damaged artery and blocking of collaterals. Repeated sympathetic blocks with novocain and repeated administration of papaverine improve nutrition through the dilated collaterals. Heparin administration can best be begun preoperatively and continued at the time of repair by its injection (50 mg.) into the artery distal to either repair or ligation.

In support of an arterial supply in the presence of a ligation of a main vessel, the application of mild, nonanesthetic refrigeration improves the chances

of survival of the relatively ischemic extremity. Such a degree of simple use of a rubberized sheet transversely and placed under toward shoulder or hip. The edges of the sheet are fastened to a metal cradle placed over the extremity which has been lightly wrapped with orthopedic sheet wadding. The open lower edge should extend down over the end of the bed for drainage when the space between the layers of rubber is filled with ice. Pressure from the weight of the ice should be looked for over the malleoli and the femoral condyles and relieved by light accessory padding. A skin temperature of 50° to 60° F may be main-



Fig 52—Mild refrigeration of an extremity obtained by placing ice between the layers of a doubled rubber sheet. Water drainage is over the foot of the bed to the floor basin. The skin temperature is controlled by the number of layers of orthopedic sheet wadding applied to the extremity.

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Arterial Temperature as a measure of the degree of

one or both lower  
tenosclerosis

The management of such a thrombosis is concerned with the use of anticoagulants to stop the progress of the intra arterial clotting, measures to abolish vascular spasm, chemotherapy particularly in cases of arterial thrombosis due to trauma and refrigeration.

The particular value of moderate refrigeration is best seen in instances of serious arterial thrombosis. Properly applied, it provides a safe interval for general management of the patient to improve his condition. The combination of diminishing tissue metabolism by cooling and increasing collateral channel caliber by sympathetic paralysis and vasodilators has resulted in surprising recovery of seemingly irretrievable tissue. Amputation is deferred until a distinct differentiation between necrotic and living tissue can be made.

## ANEURYSM

True aneurysm occurs wherever trauma or disease process or congenital abnormality weakens the wall of an artery and makes it unable to retain its normal shape against arterial pressure. The lesion produced is a *saccular aneurysm* when a small area of the vessel dilates to form a bulge lateral to its course and a *funiform aneurysm* when the weakness allows a concentric diffuse expansion of the artery.

**Arteriosclerotic Aneurysm.**—The degeneration and loss of elasticity of the vessels in arteriosclerosis is the commonest cause of aneurysm particularly of the abdominal aorta, the iliofemoral systems and the popliteal artery. The more peripheral aneurysms of arteriosclerosis, when they produce symptoms of pain due to pressure and

of the  
such an

abdominal aneurysm has been encircled with cellophane to make use of its fibrogenic effect to close the aorta slowly. Complete closure has not been reported. An instance in which improvement has been gained through this method is reported.

CASE 1 -] D., a 51 year old white man, was admitted to Hines Hospital on July 12, 1948. His principal complaint on admission was of recurring attacks of - the lower abdominal cramping and left paraumbilical re-

grade fever

One year postoperatively the mass is felt only on deep palpation. The symptoms of abdominal angina have largely disappeared. The arterial circulation of the lower extremities does not appear to have diminished.

The insertion of a large amount of wire into aortic aneurysm has in some hands given encouraging results. The most reasonable method appears to be that of Blakemore in which the manner of introduction insures tight coiling of the wire within the aneurysm and heating of the wire by measured electrical current produces clotting in the coils

to the pathologist but with recent advances in the therapy of the endocarditis and the recovery of patients with this condition they involve the surgeon as well. A case in this connection is reported

CASE VI—C.E. 25 years of age while under intensive antibiotic treatment for a bacterial infection of the left leg

common femoral artery



Fig. 53—Lateral view of common femoral mycotic aneurysm

Two months after the onset of the endocarditis and six weeks after the occurrence of the aneurysm



ligament downward 10 cm was removed after double ligation above and below. The wall of the aneurysm thus removed was thick and densely scarred (Fig 54). The ligation of the iliac artery appeared to be more hazardous because of the water hammer pulsations produced by the characteristic blood pressure of 120/40 of aortic insufficiency. The patient recovered well from the surgical procedures although troublesome drainage of lymph from the wound delayed complete healing for some weeks. He was discharged afebrile and without signs of cardiac decompensation after a total hospital course of eight months.



Fig 54—Cut surface of aneurysm after excision. Dense scar tissue which forms wall of the aneurysm is characteristic of aneurysm resulting from infected embolus.

**Traumatic Aneurysm**—Trauma to an artery occasionally may produce a true aneurysm, usually saccular when a high speed missile injures the outer coats of the vessel without penetrating it. The more usual pathology produced is however a false aneurysm or pulsating hematoma in which a blood filled cavity in the fascia and muscle planes communicates through a perforation with the vessel lumen but the portion near the defect is arterial supply peripheral to the area of damage to the continuity of the vessel. A pulsating hematoma on the other large vessels in the area. Indeed, this latter factor may be the primary one. An instance in which this was found to be true is presented in the following case. In this case a preoperative diagnosis of false aneurysm arising from injury to the profunda femoris and producing distal ischemia through pressure of the superficial femoral artery was

made. The harsh, loud bruit on the medial aspect of the thigh was thought to be due to the perforation in the profunda communicating with the hematoma while the sharper "blood pressure cuff" sound reasonably seemed to be due to compression of the superficial femoral

Arteries. At the bifurcation of the common femoral artery there was heard a strong systolic bruit with a diastolic pistol shot sound. The bruit, but not the second sound, was transmitted medially, but was not audible over Hunter's canal. The pulses of the left leg were all present, less marked than on the right.

The patient was markedly dehydrated and surgery was delayed until adequate hydration was obtained. The preoperative diagnosis was traumatic rupture of the left profunda femoral artery with hematoma formation and secondary compression of the superficial femoral artery. On April 28 the area in the left thigh was explored. The false aneurysmal sac was entered and the hematoma evacuated. A lacerated profunda femoris artery was identified and doubly ligated and the wound was closed. The patient made an uneventful recovery showing no signs of arterial insufficiency of the lower extremity.

Operative interference is required in traumatic aneurysms. If the arterial deficiency is not severe and pain is not a serious symptom, surgery is best delayed six to eight weeks after onset. This delay allows subsidence of the edema and interstitial hemorrhage in the damaged vessel and will provide the best available vessel tissue for repair.

The ideal moment — is 6 to 8 weeks

placed close to the defect so as to avoid destroying collateral branches. These, no matter how small, play a part in recovery from the arterial insufficiency caused by ligation.

The employment of sympathetic ganglionectomy as a preparatory

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but lower extremity is nevertheless good. Sympathectomy is unnecessary. Ligation, if necessary, will not greatly diminish the blood flow while evacuation of the blood tumor will increase collateral supply.

## ARTERIOVENOUS FISTULAS

**Traumatic Arteriovenous Fistula.**—Arteriovenous fistulas resulting from trauma are produced when contiguous artery and vein are injured and form a common hematoma. They produce several characteristic mechanical and physiologic changes by which they may be recognized. Because of transmission of arterial pressure to the venous system there is visible dilatation of the superficial veins. The veins may pulsate. The passage of arterial blood through the low resistance of such a fistula diminishes the efficiency of the arterial circulation distal to the lesion. This produces a degree of arterial insufficiency varying from that which causes intermittent claudication to that which brings about gangrene. The A-V shunt brings about an increased load on the myocardium by increasing stroke volume and rate. Secondary myocardial hypertrophy occurs. This increased rate may be immediately reduced by compression of the involved artery central to the fistula, and a drop in heart rate on such manual compression is a valuable diagnostic sign. The increase in venous pressure to equal systolic pressure during the systolic phase as blood passes from artery to vein results in a return flow for a briefer interval during the diastolic phase. This results in the characteristic "to-and-fro" bruit of an arteriovenous aneurysm.

The cardiac effect of a large arteriovenous fistula may be severe but is ordinarily completely reversible and the patient recovers when the fistula has been successfully treated.

Surgical treatment of an arteriovenous fistula may consist of quadruple ligation and excision rarely of repair of both artery and vein or of repair of the involved artery with sacrifice of the vein.

An instance of transvenous repair of the artery is presented

**CASE VIII—A.B.** a 29 year old male veteran was admitted to Hines Hospital on February 2, 1947 for treatment of a left superficial femoral arteriovenous aneurysm.

The patient incurred a shell fragment wound to the left thigh in November 1944. The shell fragment entered the femoral artery and vein. Since that time

compression

On February 7, 1947 a left lumbar ganglionectomy (L 2-3) was done. On February 13 the site of the fistula in Hunter's canal was exposed (Fig. 55) and

... the artery and vein was closed with a  
 c Probably as a re  
 no evidence of stasis



Fig 55—Exposure of the site of fistula and control of the vessels proximally and distally has been accomplished



Fig 56—Visualization of the fistula through the opened vein

**Congenital Arteriovenous Fistulas.**—Congenital arteriovenous fistulas present a more difficult problem. They are generally consid

## ARTERIOVENOUS FISTULAS

**Traumatic Arteriovenous Fistula**—Arteriovenous fistulas resulting from trauma are produced when contiguous artery and vein are injured and form a common hematoma. They produce several characteristic mechanical and physiologic changes by which they may be recognized. Because of transmission of arterial pressure to the venous system there is visible dilatation of the superficial veins. The veins may pulsate. The passage of arterial blood through the low resistance of such a fistula diminishes the efficiency of the arterial circulation distal to the lesion. This produces a degree of arterial insufficiency varying from that which causes intermittent claudication to that which brings about gangrene. The A-V shunt brings about an increased load on the myocardium by increasing stroke volume and rate. Secondary myocardial hypertrophy occurs. This increased rate may be immediately reduced by compression of the involved artery central to the fistula and a drop in heart rate on such manual compression is a valuable diagnostic sign. The increase in venous pressure to equal systolic pressure during the systolic phase as blood passes from artery to vein results in a return flow for a briefer interval during the diastolic phase. This results in the characteristic "to-and-fro" bruit of an arteriovenous aneurysm.

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**CASE VIII.**—A B, a 29 year old male veteran, was admitted to Hines Hospital on February 2, 1947 for treatment of a left superficial femoral arteriovenous aneurysm.

The patient incurred a shell fragment wound to the left thigh in November 1944 and following a period of hospitalization was returned to duty. Since that time

compression

On February 7, 1947 a left lumbar ganglionectomy (L 2-3) was done. On February 13 the site of the fistula in Hunter's canal was exposed (Fig. 55) and

ciated congenital abnormalities which could produce an inadequate deep venous circulation, a venogram showing adequacy of the deep veins must be accomplished first.



Fig. 57 Ischemia of finger tips and atrophy of forearm result of congenital arteriovenous fistulas in Case IX



Fig. 58—Arteriogram in Case IX produced by injection of brachial artery shows immediate filling of dilated veins but gives little information concerning site of fistulas. Note lack of visualized vessels distal to carpus and atrophy of phalanges.

CASE X—J. C., a 19 year old factory worker was admitted to the hospital with a history of a long-standing, progressive, and severe pain in the right arm and hand, which was worse at night and on exertion. The pain was described as a burning, tingling, and numbness, and was accompanied by swelling and discoloration of the hand and fingers. The patient had no history of trauma or infection, and no family history of similar symptoms. Physical examination revealed a right arm and hand that was swollen, red, and tender to touch. The fingers were numb and tingling, and the patient had difficulty moving the hand and fingers. The rest of the physical examination was within normal limits. Laboratory studies, including a complete blood count, serum electrolytes, and a urinalysis, were all within normal limits. A venogram of the right arm and hand was performed, and it showed a large, dilated vein in the upper arm, which was the source of the pain and swelling. The venogram also showed a large, dilated vein in the hand, which was the source of the numbness and tingling. The results of the venogram were consistent with a congenital arteriovenous fistula. The patient was treated with a surgical procedure to remove the fistula, and the pain and swelling resolved. The patient has remained well for several years after the surgery.

ered to be the result of failure of the arterial and venous portions of the vascular anlage to separate. The anomaly most commonly affects one arm or one leg where it produces an excessive warmth, an increase in venous channels and frequently an overgrowth of the extremity. It is often associated with capillary hemangiomas of the skin of the involved part. The characteristic "to-and fro" murmur may be present having multiple areas of greatest intensity due to multiplicity of the lesion. In other cases the murmur may be absent probably because of the smallness of the communicating channels.

The signs may be present from birth or may suddenly appear at ages of 12 to 30 following incidental trauma. The A V shunt may produce a painful ischemia followed by gangrene progressively involving one digit after another or may merely cause distressing subcutaneous venous engorgement.

Operative treatment has been disappointing. Successful removal of one or two areas of fistula bearing vessel is followed either by occurrence or by recognition of others. The case reported below has been treated in such a manner. The impression gained in this case is that innumerable prefistulas are present but inactive because of the relatively small difference between arterial and venous pressures. When an active fistula is surgically closed by any means others open due to the increase to normal of this arteriovenous pressure difference.

CASE IX—C V V a 26 year old white male veteran was admitted to Hines

On admission there was atrophy of the left forearm and hand with marked venous engorgement of the subcutaneous veins. The tips of the first through the fourth fingers were gangrenous (Fig 57). A loud to-and fro murmur was heard best over the distal portion of the radial artery. The noise disappeared on com-

Much of the discomfort of the silent arteriovenous fistula may be removed by obliteration of the very large subcutaneous venous channels by ligation or sclerosis or both. Owing to the possibility of asso-

These complaints seem certainly to be based on insufficient arterial supply to the calf or intrinsic foot muscle (1) during exercise in the instance of intermittent claudication and (2) during the depressed circulation of sleep in the instance of night cramps. In the first instance rest allows for metabolite removal and regaining of ability to walk while in the second dependency and exercise improves the efficiency of the arterial supply and relieves the cramps and ache.

A second group of complaints is related to more severe and constant ischemia of one or more digits. The patient will state his toe or toes have been painful for some weeks or a minor injury on the foot has failed to heal.

Examination of the individual must be designed to determine how serious the arterial obstruction is and how much is due to additional arteriospasm.

The skin color, temperature and texture are examined comparing the two sides. A pallid cyanosis of the toes and foot associated with rapid gradient in temperature drop above the ankle is a common finding in severe obstruction. The pulses in the femoral, popliteal, posterior tibial and dorsalis pedis areas are looked for. Skin pallor to a cadaveric degree may be induced by elevation of the legs. Two phenomena are observed on dependency after this period of elevation. In the absence of varicose veins the length of time between dependency and the filling of the subcutaneous veins about the ankle gives an index of arterial flow. In the normal the filling is almost instantaneous; in arterial deficiency the time may be five minutes. The appearance of rubor or reactive hyperemia in the skin of the feet on dependency provides some information in arterial insufficiency. In the normal reactive hyperemia appears immediately and fleetingly if at all. In deficiency of arterial circulation the rubor is delayed and intense.

Information pertaining to the part played by vasospasm in the arterial insufficiency is next sought. The "claudication distance" is measured by having the patient walk until pain first appears, record the distance and then continue until he must stop. Next in a room as stable in temperature as possible the skin temperature is measured on each toe and at points up the leg after a period of thirty minutes of exposure of the skin in the room. This is done with the patient in prone position with any thermocouple or resistance apparatus which

th

ings are repeated. The patient is then asked to repeat the exercise tolerance test.



admission was precipitated by an incident of minor trauma two weeks previously to the skin over this enlarged vessel at midleg level. The small laceration bled severely until firm pressure was applied and bleeding recurred twice during

11 per minute

A diagnosis was made of congenital vascular anomalies of the extremity including arteriovenous fistulas. Obliteration of the greatly enlarged saphenous vein was thought advisable if it could be demonstrated that no anomalous insufficiency of the deep veins was present. At operation the common femoral vein and its tributaries were explored without interruption of the saphenous. It was found that the common femoral vein was represented by two very large venous trunks. The superficial femoral vein was likewise double and the profunda femoris branches were multiple, at least four large branches being visualized. Multiple ligations of the saphenous vein were then accomplished resulting in apparently complete collapse of the vein. Since the operation the patient has volunteered the statement that the leg feels lighter and does not tire as easily as before. This has raised the possibility that the flow in the saphenous vein may have been retrograde despite the increased pressure within it.

In the absence of the typical "to-and fro" murmur, evidence of an A-V shunt can be found in pulse rate reduction on compression of the artery at the base of the involved extremity. Comparison of the oxygen tension of venous blood taken from analogous sites on the involved and normal sides will show increase on the involved side in congenital arteriovenous aneurysm.

#### GRADUAL ARTERIAL OCCLUSION

**Arteriosclerosis.**—The common pathology causing chronic arterial insufficiency of heart, viscera, central nervous system or extremities is arteriosclerosis in one form or another. Patients presenting symptoms of arterial insufficiency of the extremities are found from the age of 40 in rapidly increasing numbers in each older decade. Men outnumber women at least 5 to 1.

The presenting complaints are almost routinely in the lower extremities and are remarkably uniform. Pain is represented in two forms,

nearly the same distance before there is recurrence of the pain.

Many patients complain of night pain and night cramps in the calf or plantar regions. It is seemingly contradictory that a moderate amount of exercise such as walking up and down the bedroom once or twice relieves this pain.

machines that produce alternate suction and pressure on the extremity in a transparent boot, and the Burdick machine which produces a venous distention by rhythmic compression by inflatable cuff at the upper thigh or arm. Of these methods the Burdick machine has produced the best results in our hands. We believe this to be because the cuff can be left on and working during the night and provides the longest period of passive exercise.

Medical treatment has the purpose of overcoming the very important reflex phase of the vascular obstruction. This aspect of treatment has received recent impetus through the use of intravenous ether compounds dibenamine and possibly the use of ascorbic acid and histidine together to elaborate histamine in the tissues. We have had experience with tetra ethyl ammonium and dibenamine and value their use during the acute stages of the disease.

Surgery in Buerger's disease provides essentially permanent interruption of the vasospasm by appropriate sympathectomy. This should be applied during the quiescent stages in patients who show improved skin circulation when sympathetic novocain block is done. In selected cases having areas of gangrene otherwise doubtful stump healing levels can be used in amputation when sympathectomy precedes it. The application of sympathectomy must be cautious. The relaxation of nondiseased trunk and collateral arteries in the upper leg may be detrimental if so much of the arterial structure in the foot is involved that only a small percentage can dilate. The pressure reaching the foot may be reduced by increasing the flow through the upper leg and as a result the foot may become gangrenous following sympathectomy. This response can be avoided by the observation of accurate skin temperatures at many levels and on multiple points of the foot before and after novocain block. Areas in which this danger exists will fall rather than rise in temperature. Amputation of parts which showed cooling during block, accompanied by sympathectomy is a logical form of treatment. This regimen has resulted in a high proportion of healing by first intention in the stumps at toe, metatarsal or leg level and confidence is felt that neither too much nor too little tissue is sacrificed.

Increases in skin temperature in part represent increase in skin blood flow and in part loss of sweat evaporation. Increase in "claudication distance" represents in part improvement in muscle arterial supply and in part the absence of any pain which might be the result of vasospasm due to ischemia.

The results of these observations aid in determining the usefulness in the individual of sympathectomy for relief of symptoms and delaying ischemic necrosis. It is also necessary information in determining whether sympathectomy would lower the level of an imminent and already planned amputation.

**Buerger's Disease**—Buerger's disease (thromboangitis obliterans) is an inflammatory disease of unknown etiology affecting the blood vessels. Although visceral vessels particularly of the heart, brain and mesentery may be involved the condition ordinarily involves the medium and small vessels of the extremities. The involvement is typically segmental. It affects the arterial elements more frequently and severely than the venous.

Seen almost exclusively in males the disease rarely appears before the age of 22 or after the age of 45. The involvement is characteristically segmental, leaving adjacent areas of vessel normal. Ordinarily the disease is active for periods of a few weeks to a few months and then becomes quiescent for a time before activity recurs.

The ischemia produced by the closures effected by each episode becomes more and more severe but during each exacerbation an ischemia occurs greater than can be accounted for by the pathologic anatomy. That this is due to an intense continuous vasospasm is evidenced by the improvement seen during use of novocain sympathetic block and, to a lesser degree, administration of vasodilatory drugs.

Ischemia progresses to gangrene which ordinarily is first seen at the tips of the toes or fingers. Occasional appearance of primary gangrene on the heel, ankle or leg is due to unusual trauma to the ischemic skin.

Pain in thromboangitis obliterans is of two types. Commonly it is a constant aching and burning pain of moderate degree which becomes more severe on elevation. Pain takes the form of intermittent claudication less commonly in Buerger's disease than in obliterating arteriosclerosis.

Treatment of the condition consists of removal of all elements presently suspected of contributing to the etiology. The strongest suspicion rests on the use of tobacco and total abstinence must be required. Removal of foci of infection cannot be ignored. An adequate diet and adequate fluid intake are required.

Physical therapy to encourage the growth of arterial collaterals takes the form of Buerger's exercises alternating elevation with dependency of the extremity, passive vascular exercise in the form of

of a forceps may cause particles of the dye to be left behind and continuation of local necrosis infection and discoloration

Grease injected into the finger or hand accidentally by way of a pressure grease gun may enter through a very innocent looking portal, infiltrate the tissues extensively causing ischemia due to pressure, and a chemical irritation resulting in necrosis varying in amount to the grease infiltrated. The involved pale, tense tissue requires immediate care. Under strict surgical cleanliness the tissues are laid wide open and the grease is removed as completely as possible to relieve tension and irritation. If this is not done amputation or plastic repairs are most likely to follow the necrosis and inflammatory reactions.

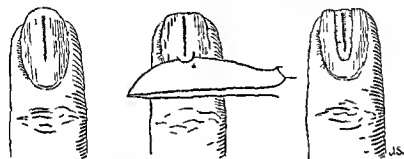


Fig 59—A satisfactory method for complete removal of foreign bodies from beneath the finger or toe nail (1) Trim the finger nail and then shave the nail off from above the foreign body. This can easily be done at any part of the nail with a sharp scalpel. (2) After the foreign body has been completely exposed it can be lifted out completely and the area is then washed well with soap and water. This can be done without discomfort or the use of anesthesia if the operator is gentle.

Too often when foreign bodies are pulled out from beneath the nail by grasping the protruding end, dirt and particles of the offending material are left behind to cause infection and in some cases prolonged convalescence. The above method is a wound toilet and if well done should prevent complications.

Not infrequently a patient is seen following a fall onto a gravel or cinder roadway with foreign particles ground into the skin of the face and forehead. Under general or block anesthesia a careful gentle but complete removal of the particles should be done. Much can be accomplished by washing the area well with soap and water, a brush as used for a surgical scrub may complete the job. Some particles may still remain which must be picked out or literally dug out of the deeper layers of the skin. After this procedure a gentle washing with soap and water is followed by an irrigation of sterile water or normal salt solution. This should prevent a discoloration.

The skin of mucous tissues are notorious as conveyors of tetanus and

## FOREIGN BODIES

EGBERT FELL, M D \* AND FAY H. SQUIRE, M D †

### MANAGEMENT OF FOREIGN BODIES

THE management of foreign bodies evolves around the type of foreign body, infection, the damage done or likelihood of being done, and localization. These will be discussed according to the foreign bodies most commonly encountered in the various tissues or organs of the body.

**Skin and Subcutaneous Tissues**—A large group of foreign bodies becomes lodged in the skin and subcutaneous tissues. This includes splinters, thorns, glass, pins, needles, hairs, indelible pencil points, oil under the skin from pressure gun, and other foreign materials.

two hours and use warm, moist, sterile packs or soaks four times a day for one hour at a time to localize the possible infection and to maintain an opening at the site of penetration for drainage. Inspection in twelve to twenty four hours will usually reveal whether any infection is developing and chemotherapy and antibiotics can be used along with continued splintage, rest and surgical drainage if necessary.

A small splinter of wood under the nail may carry with it a very virulent organism giving rise to acute local and rapidly spreading lymphangitis with its known serious complications. Such a wound must be treated with respect and the surgical principles of early, complete wound toilet instituted. Removal of the roof of nail over the foreign body allows for complete débridement, cleansing and drainage, yet the major uninvolved part of the nail bed is protected by the remaining nail (Fig. 59).

Indelible pencil injuries are of a serious nature and require special attention. The point should be removed as soon as possible. The nail should be removed and the wound completely excised. Removal of the point by extraction with the aid

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scope It is important to place the patient in a convenient position for operating and for access to the site from which the foreign body is to be extracted at the time localization by x ray is carried out The incision should cross the long axis of the foreign body Palpation through the knife point is better than by digital examination and retraction of tissues should be minimal to avoid moving the foreign body

If localization by turning the patient fails it is permissible to resort to biplane fluoroscopy provided the radiologist protects the surgeon and the patient from x ray injury This can be accomplished by short exposures and insisting that the surgeon keeps his hands out of the fluoroscopy field Surgery is accomplished in the interim between fluoroscopic localizations

The detection of a foreign body is not an indication for surgical removal The location, the damage done or likely to be done, the contamination carried in and the accessibility are the essential points for study to determine the treatment Whenever there is a persistent sinus or an area of repeated inflammatory reactions or whenever repeated hemorrhages occur in an inflamed area a foreign body must be considered as a cause for late manifestations Its removal will usually lead to rapid healing

A serious error is the attempt to remove foreign material using local infiltration anesthesia, which distorts the field Likewise, a bloody field is most often associated with defeat of purpose There are no more important requirements when endeavoring to find and remove foreign bodies than good x ray localization an operative field undistorted and free of blood and complete anesthesia in a well equipped operating room

Foreign bodies in themselves may be harmless to the tissue but the organisms carried in must always be considered dangerous A high velocity bullet or shell fragment may be an exception if clothing does not accompany it All foreign bodies should be considered conveyors of organisms and preventive measures against infection should be instituted at once whether the foreign body be one that is easily removed or will require a formidable procedure Prophylaxis against tetanus and gas infections must always be considered both in recent and delayed removal of foreign bodies We have known innocent appearing wounds to be followed by tetanus and death The recent war has well proved the importance of immunization for the prevention of tetanus

Compound fracture seen with f — 1 1

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

gas organisms Complete excision of the wound including the gun wad with specific prophylaxis against these infections plus penicillin and sulfa drugs are definitely indicated

**Deeper Structures**—These are mostly metallic objects, gunshot or

may be necessary to determine the general position of the foreign body These films must include most of the body as a bullet entering

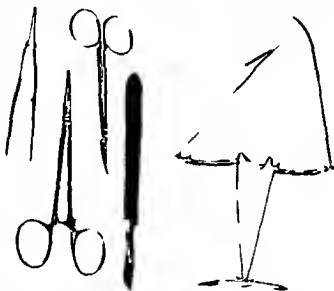


Fig. 60—Instruments that are of great aid in the removal of small foreign

the chest may lodge in the abdomen Once they become detected accurate localization is necessary for their removal This may be accomplished by many standard procedures each of which has worked satisfactorily in the laboratories where they have been developed. Our method makes use of the ordinary fluoroscope in which the site of the foreign body is marked on the skin above and below the object. A

**Eye.**—Most of the foreign bodies in the eye are airborne, and lodge on the conjunctiva or cornea. These can be wiped off gently with a moist cotton applicator. Embedded particles and intraocular foreign bodies should receive the early attention of the ophthalmic surgeon. If these are radiopaque they can be localized accurately on eye charts by various methods (we use the Sweet localizer). If the foreign body is glass it is helpful to the radiologist to have a piece of the glass to determine its opacity.

**Ear and Nose.**—These foreign bodies are usually objects inserted by children. They may cause severe damage and if they are not easily removed the patient should be referred to an ear, nose and throat specialist.

**Larynx, Trachea and Bronchi.**—The foreign bodies in the larynx, trachea and bronchi are of two types: those aspirated during surgical procedures such as pieces of tonsil, teeth or dental appliances and objects carelessly held in the mouth and accidentally inhaled into the air passages during talking, laughing, coughing or sneezing. The symptoms and findings depend on where they come to rest. The early symptoms are coughing, choking and gagging and if the larynx is the point of lodgment, dyspnea, wheezing and coughing may predominate. Asphyxia may be the dominant picture if obstruction is complete either by a large foreign body or inflammatory reaction to the foreign body. The endoscopist should be called as soon as a foreign body is considered present in the trachea or bronchi. Opaque foreign bodies are easily seen on the x-ray film (Fig. 63). Nonopaque

emphysema either  
expiration Biplane  
all foreign bodies

in the trachea and bronchi can be removed through the bronchoscope with little risk in the early period. Early diagnosis and removal may prevent one or more of the many complications that may follow foreign bodies in this location.

**Gastrointestinal Tract.**—Foreign bodies may accidentally or with intent pass through the mouth and a great variety of objects have been

Infants  
swallow

preventing palatal detection of the presence of foreign bodies in the food contribute to the number of foreign body accidents. These objects may lodge in the esophagus and require an endoscopist for removal (Fig. 64).



bodies such as wire screws, or plates." This statement of Sir Watson Jones should have been read and followed more closely by Army surgeons of the past war for far too often we saw at a General Hospital patients in whom screws, nails and the like had been inserted in infected compounded fractures. The condition of the patients was un-



Fig 61



Fig 62

WELL, FAY H. SQUIRE and frac

added in  
possible

satisfactory upon arrival at the hospital requiring removal of the surgically introduced foreign bodies in spite of prolonged chemotherapy. If the presence of a foreign body or sequestrum is permitted at a fracture site, bony union is prolonged or may be prevented. Osteomyelitis with a chronic sinus is a common sequel (Fig 61). The sooner such foreign bodies are removed, the better.

moved from the stomach. However, a trial of a few weeks to see whether or not these objects will pass through the pylorus is safe. Perforation by a sharp object is not common but may occur at any

fish bones have slowly perforated the bowel causing abscesses and fistulas. A bone may lodge at the anal orifice and cause sudden, severe pain which is relieved only by removal. This injury may give rise to a perirectal abscess. In the Children's Ward at the Cook County Hospital, we have removed open safety pins stuck in the pyloric end of the stomach (see Fig 65) and duodenal jejunal junction. A five-cent piece swallowed by an infant did not pass through the stomach and required removal. It is rare indeed for a foreign body to require removal and conservative therapy is indicated, which consists of a regular diet, no cathartics, careful attention to stools, and x-ray follow-up for all sharp pointed objects every two or three days until the object is passed. We believe hospitalization is indicated for all in the latter group.

The penetration or perforation of a viscus by a bullet, shell fragment or any other object calls for surgical repair as soon as the patient is in condition for operation. It was shown during the past war that the period of preparation is extremely important. Shock must be overcome by blood and plasma and the stomach deflated by aspiration before surgery is attempted. The foreign body is of little concern compared to the wounds caused by it. Stomach and small bowel wounds should be closed; wounds of the large bowel require a colostomy proximal to or at the site of injury.

**Urinary Bladder.**—Many kinds of foreign bodies have been found in the urinary bladder, some arriving by way of the urethra accidentally following surgery or catheterization; others during acts of masturbation. Some come by way of the bowel, such as sharp pointed objects which slowly perforate causing a fistula and fecal contamination of the bladder. Removal through the cystoscope is possible if the object is small and recently acquired. Foreign bodies present in the bladder a long period are usually surrounded by urinary salts; these and larger foreign bodies will require a suprapubic removal. The diagnosis is made from the symptoms of dysuria, frequency, and pus and blood. X-ray may reveal the foreign body, but cystoscopic examina-

### PREVENTION OF FOREIGN BODIES

Industry now recognizes the importance of the prevention of foreign body accidents. It also behooves all doctors and nurses to teach students and patients the prevention of these accidents, which

Detection and localization is sometimes difficult. The use of cotton impregnated with barium sulfate or capsules containing barium sulfate swallowed during fluoroscopy will lodge on the foreign body and help with localization. Once they have passed into the stomach most

Fig. 63



Fig. 64

Fig. 63.—*Left* Tack inhaled into right bronchus *right* after removal through bronchoscope

Fig. 64.—A corn lodged at upper esophagus successfully removed by endoscopist.

indicated. Large corns and other

occur too frequently in the care of the sick. Great care in giving hypodermic injections must be taught so that the needle does not break off and become lost in the tissues (see Fig 62). This is best done by insisting that the needle be sharp and never buried to the hilt. If intramuscular injections of any size are to be given to a patient who is not fully cooperative, restraints must be used. We must also impress the importance of not leaving open safety pins about. One of the common practices noted in some nurseries is the sticking of open safety pins into the bedclothing while caring for the child. A closed safety pin is a "safe pin." An open pin may lodge in the gastrointestinal tract or air passages (Fig 65). In the operating room the surgical team must at all times be absolutely sure that the sponge and instrument count is correct before closing the wound, primarily for the patient's welfare but also for the reputation of the hospital and surgeon (see Fig 66).

### CONCLUSIONS

1 A few of the multitude of problems concerning foreign bodies embedded in tissues have been discussed.

2 The detection of a foreign body is not an indication for surgical removal. The location, the damage done or likely to be done, the contamination introduced and the accessibility are the essential points for study in determining the treatment.

3 Accurate x-ray localization is essential before surgery is attempted.

4 A nondistorted bloodless operating field is important for success in finding foreign bodies.

5 At all times in both early and delayed removal of foreign bodies infection must be prevented and combated by sound surgical principles and chemotherapy.

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Fig. 65



Fig. 66

Fig. 65—Safety pin stuck in pylorus of a 2 year old child. It was surgically removed four days after accident with recovery.

Fig. 66—Foreign bodies accidentally left in the abdomen at time of operation. *Left*, Tissue forceps present in pelvis twelve years with very minor symptoms until just prior to removal at which time there was rectal discomfort. Digital examination revealed the instrument to be between the sacrum and rectum. It was removed easily after excising the coccyx and gently extracting the pieces. *Right*, A 1 1/2 inch long piece of wood protruding from the abdominal wall.

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## **SPRAINS AND MINOR FRACTURES**

**CARLO SCUDERI, M D , Ph D , F A C S \***

### **SPRAINS**

**SPRAINS** are tearing of the surrounding ligaments of a joint which has undergone a force sufficiently powerful to produce a temporary subluxation. When the force has ceased acting the subluxation disappears, leaving the joint with a torn or severely stretched supporting ligament, and in severe cases a damaged capsule. Should the original force continue and be powerful enough dislocations, fractures or fracture dislocations will occur.

**Etiology.**—The causes of sprains are numerous. In children they are frequently the result of violent physical activity associated with an abnormal strain upon an articulation which has a restricted range of motion. Sprains in articulations that have a wide range of motion are uncommon, dislocations being the rule. The shoulder joint, for example, is freely movable in all directions and consequently is much more frequently dislocated than sprained.

The ankle joint, which has limitations of free range of motion in all directions, sustains more sprains than any other joint of the body. It is frequently subjected to twisting violence in athletics and sprained ankles are common in football, basketball and baseball. Off the athletic field sprains of the ankle are frequently caused by a fall on slippery pavements or by tripping on irregular surfaces, the mechanism being one of inversion of the foot with tearing or elongation and shredding of the lateral ligament of the ankle joint.

Sprains of the knee are second only in frequency to sprains of the ankle. Sprains of the knee result from twisting forces, often plus the shearing forces applied to the articulation in physical contact. Thus in football players, in addition to the twisting force employed by the athlete himself, there is thrown upon the extremity the added stress and strain from an attempt by another player to upset the runner.

hours during the day sprains of the back may occur. They usually produce only a transitory discomfort of the low back and rarely are

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the damaged ligament with difficulty of movement of the affected joint. Within a brief period of time, swelling occurs which is a combination of extravasation of blood, serum and in some cases, synovial fluid from the associated joint.

On palpation of the injured area, it is found that the point of localization of discomfort is not over the bone proper, but is directly over the soft tissues which surround the involved articulation. It is most important that the point of pain be well localized in order to assist in the differential diagnosis between a sprain and an actual fracture.

**Diagnosis.**—X ray films of the affected joints should always be taken when a clinical diagnosis of sprain has been made, as all too frequently associated fractures terminating in prolonged disability, are overlooked. In cases diagnosed as sprains of the ankle there is often an associated avulsion fracture either of the external or internal malleolus, sometimes an avulsion fracture from the anterior lip of the tibia and sometimes a partial avulsion of the anterior superior portion of the astragalus is found. In the wrist joint, too, a linear fracture of the navicular bone may be overlooked or a subperiosteal fracture of the radius or ulnar styloid may not be diagnosed purely because the attending physician has wished to avoid the additional expense to the patient of the making an x ray study.

In sprains, the localization of pain is always over the soft tissues. In linear or subperiosteal fractures, the pain is always localized to the bone. A point of well localized tenderness over one of the bony protrusions or over one of the carpal bones in the wrist should make one strongly suspicious of the presence of an associated fracture.

In the differential diagnosis, it is most important, as already stated that one be sure that no fractures or subluxations of the joints exist.

It is regrettable that in practically all instances, no x ray films were even suggested by the attending physician. This occasionally leads to medicolegal complications that are most unfavorable and unsavory for everyone.

**Prognosis.**—The ultimate prognosis in sprain is favorable. Practically all sprained ankles, knees, wrists, elbows and lower backs recover completely if adequate treatment and immobilization are instituted early. If the ligament is permitted to heal in its normal relationship without additional fibrosis, there is no reason to anticipate any complications. On the other hand, if sprains are neglected and the ligaments heal in a relaxed position, the joint is weakened and will not have the stability which is so important, especially in weight-bearing joints such as the knee and ankle.



incapacitating beyond a few weeks. The lumbosacral area is most frequently the site of sprains produced by excessive stretching. The elongation or actual tearing of one or more of the ligaments which support the lower back occurs more commonly than is believed by many physicians who do not see a great number of industrial cases.

Needless to say, associated pathologic states may exist in the lower back with sprains and for this reason all low back sprains should be examined carefully by a competent orthopedic surgeon, with adequate x ray films, before the patient is discharged with an optimistic prognosis. Only by the greatest of care are some of the more complicated causes of low back sprains identified and adequately treated.

**Pathology.**—In mild cases the entire pathology is limited to the ligament which is damaged. This ligament being of a nonelastic nature will first shred and the fibers will be partly elongated with some tearing of the individual fasciculi. If the force continues an actual complete disruption of the continuity of the ligament occurs. Associated with this tearing of the ligament there is by necessity, damage to the surrounding tissues such as the subcutaneous fat, the fascia, the skin and the underlying capsule. With the associated trauma the capsule itself frequently becomes ruptured with an exudation of some of the

to doctors to be described in detail, but briefly, the clot slowly becomes replaced by fibrous tissue and a revascularization occurs until the extra vascular blood becomes completely absorbed and is replaced in some degree by fibrous tissue.

In some cases the fibrous replacement of the clot remains as a permanent swelling. In most instances complete absorption ultimately occurs with a mild amount of fibrosis of the surrounding tissues. If the ligaments and capsule are adequately protected the restitution of the normal continuity of the soft tissue is frequently almost complete. However, if irritation from stresses and strains occurs during the healing process an overabundance of scar tissue is formed with increased fibrosis. The torn capsule and torn ligament become thicker than normal and are replaced by fibrous tissue in the damaged area.

Unless repeated damage occurs to this area the fibrotic substitution of the normal ligament and capsule in the area of the injury re-

reason, the period of pain and discomfort is much less in traumatism to soft tissues of good vascularity.

**Symptoms and Signs.**—Immediately at the onset of a sprain the patient complains of exquisite localized tenderness over the area of

as possible to the sport in which he was engaged. For this reason every attempt has been made to shorten the period of convalescence. These trainers are the ones who originated the immediate use of the extremity following a sprain. Individuals who follow this school of thought recommend that the sprained extremity be immersed in ice water for a period of thirty to forty five minutes in order to produce hemostasis and a minimal amount of soft tissue edema. Next an elastic pressure bandage is applied and the patient is discouraged from using crutches or a cane to eliminate weight bearing. After twenty four to forty eight hours hot soaks and massages are ordered and active exercises of the extremity is performed. Within a period of five to seven days baseball, basketball and football players have been sent back into unrestricted activity and the ultimate end results have been considered most favorable. This type of treatment was first recommended by Thordike.

Arnulf and Frick in 1934 first recommended the local injection of sprains and the immediate mobilization of the extremity. Leriche in 1936 reported favorable results from the method and a number of men now advocate it.

During the recent conflict a number of physicians had the opportunity of treating a great many sprains by both methods. This was especially true of those stationed with the paratroopers and also those with the Marines who practiced landing operations. McVasters treated over 200 cases by the injection method using procaine hydrochloride and it was his opinion that irrespective of treatment the patients who returned immediately to normal activity did better than those who did not.

The injection treatment is quite simple to apply. The point or points of exquisite tenderness are well localized on the patient's extremity then 5 to 10 cc. of 1 per cent novocain or procaine hydrochloride is injected into each tender point until all of the points of tenderness about the sprained joint are completely anesthetized and free motion of the articulation is possible. The extremity is then strapped with some form of pressure bandage. Limited activity is permitted for a period of five to seven days thereafter but under no circumstances is the patient permitted to rest the extremity or immobilize it in any way or form. No crutches are used for the lower extremities and no splinting is applied to the upper extremities.

In my own limited experience in the local injection and early mobilization of sprained articulations I have found the method to be very efficient in a great percentage of cases.

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Individuals who have repeated sprains especially of the knee of

of thought One advocates adequate immobilization for the healing of the torn ligament and associated soft tissues in as close approximation to normal as possible This requires immobilization from four to eight weeks depending on the severity of the sprain and associated pathologic changes The other believes in immediate active weight bearing and use of the extremity within a few hours of the time of the injury Both schools claim excellent results

Those who believe in adequate immobilization for the healing of the torn soft tissues recommend immediate elevation of the extremity

changes  
minimal

pressure and cold compresses the extremity is immobilized either by the use of adhesive tape elastoplast or a cast The choice of immobilization of course depends on the joint involved, the severity of the trauma and the judgment of the attending physician

Should a large hematoma occur in a joint such as the knee with considerable distention of the joint proper and the surrounding tissues, aspiration of the joint is desirable Blood acts as a foreign body in an articulation and its removal minimizes subsequent fibrosis in the joint However if the swelling of the joint is not too great it is best not to aspirate the joint because it introduces another element of danger

Evacuation of a subcutaneous hematoma is to be condemned unless the hematoma is unusually large and the viability of the overlying skin becomes questionable Evacuation of course must be done with anesthesia under the most aseptic conditions with immediate primary

sprains and that a  
surrounding joint is more apt to be attained if these principles of treatment are followed

For a good many years athletic trainers have done everything possible to rehabilitate the athlete so that he could return as quickly

finger in a well trained violinist constitutes a major fracture with a possibility of a ruination of his entire career. On the other hand a fracture of the femur in a person who is advanced in age and thus will not expect to participate further in major physical activity certainly by comparison could be considered a minor fracture. For this reason all fractures which I believe likely to be associated with disability or poor ultimate outcome are purposely avoided in this discussion.

**Fractures of the Phalanges of the Fingers and Toes**—Fractures of the terminal phalanges of the fingers and toes may be considered in one group. The etiology of both is in most instances a crushing blow to the phalanges produced by a closing door, the falling of a box, a blow by a hammer or similar mishap. In practically all instances although the bone is broken the soft fibrous tissue that surrounds it prevents any major displacement. Comminution of the



Fig. 68—A Comminuted fracture of the terminal phalanx of a large toe. B Comminuted fracture of the terminal phalanx of an index finger.

phalanx is common. Unless the soft tissue damage is of such severity to produce gangrene and sloughing of the overlying soft tissues these fractures are minor in nature. Frequently they do not even require immobilization. However, because they are frequently bumped and produce much pain and discomfort to the patient, it is best to immobilize the distal two phalanges with a small tongue depressor or aluminum splint. This should protrude about  $\frac{1}{4}$  inch beyond the end of the finger or toe so that there is complete avoidance of trauma or bruising to the delicate injured phalanx (Fig. 68).

In all cases the symptoms subside and the patient has good use of the terminal phalanx in a period of three to four weeks after the original injury. Solid bony union of these comminuted fragments is unusual. The usual end result is a fibrous union which clinically is firm and substantial, yet radiographically for nine months to a year thereafter and in some cases permanently, the fragments may appear in practically the same position and with the same general outline and the same gap between the fragments as existed immediately

plaster owing to its inelasticity, very frequently produced linear ulcerations about the bandaged articulation and did not permit good mobility in spite of firm pressure and semi immobilization. Adhesive tape application was difficult as creases frequently occurred and a great deal of patience and skill was required to strap an ankle knee wrist or elbow without producing some pressure points.

With the advent of elastoplast and similar preparations that have a good adhesive base and elastic power, any articulation can be very snugly compressed and receive simple figure-of-8 bandaging or of making a figure of 8 about ar . . . well known to warrant description.

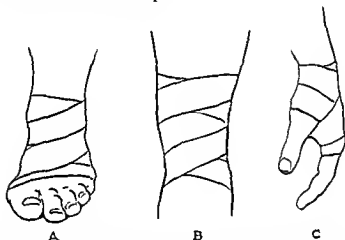


Fig 67—A Application of an elastic adhesive plaster to the ankle. This form of strapping is most efficient as one not only has support but moderate pressure with no danger of underlying pressure areas. B Strapping of a knee with an elastic adhesive plaster. C Strapping of a wrist with an elastic adhesive plaster.

The discussion of the treatment of low back sprains is purposely avoided in this article, as it falls into an entirely different category than sprains of the extremities and opens up a field of marked argumentation that would go far beyond the purpose of this paper.

#### MINOR FRACTURES

By minor fractures is meant fractures of such a nature that, regardless of whether or not the physician who manages them has had special orthopedic or traumatic surgical training, the ultimate outcome will likely be favorable. There exists altogether too frequently the erroneous idea that simply because a small bone is broken the fracture is minor in nature. It does not require much argumentation to convince anyone that the fracture of the terminal phalanx of the index

finger in a well trained violinist constitutes a major fracture with a possibility of a ruination of his entire career. On the other hand a fracture of the femur in a person who is advanced in age and thus will not expect to participate further in major physical activity certainly by comparison could be considered a minor fracture. For this reason all fractures which I believe likely to be associated with disability or poor ultimate outcome are purposely avoided in this discussion.

**Fractures of the Phalanges of the Fingers and Toes**—Fractures of the terminal phalanges of the fingers and toes may be considered in one group. The etiology of both is in most instances a crushing blow to the phalanges produced by a closing door, the falling of a box, a blow by a hammer or similar mishap. In practically all instances although the bone is broken the soft fibrous tissue that surrounds it prevents any major displacement. Comminution of the



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after the original injury yet the patient has been asymptomatic for a period of many months. These findings are usual not unusual in this type of fracture and are often surprising to men who have not seen a large number of comminuted fractures of the terminal phalanx

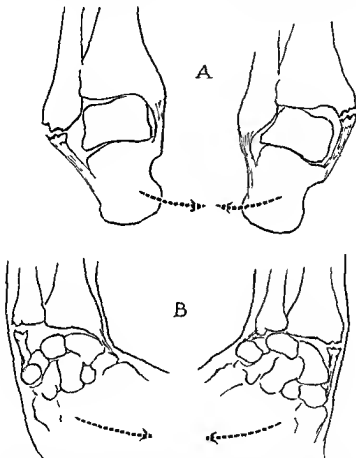


Fig. 69—A Fracture-sprain of the external and internal malleolus. One is produced by inversion and the other produced by eversion. B Fracture-sprain of the ulnar styloid and the radial styloid. One is produced by radial deviation and the other by ulnar deviation of the wrist.

**Fracture-Sprains**—In this group of cases are included a number of common injuries in which the attachments of the ligaments to bony prominences have been pulled off with the ligament by some

unusual stress or strain. The continuity of the ligament is not actually disrupted but its periosteal attachment is pulled off together with a slight amount of underlying bone so that from a clinical standpoint the patient actually has a sprain but from a radiographic and medical standpoint he has a fracture (Fig 69). It is important that these cases be diagnosed early because the entire success of the treatment depends on the return of the normal tension to the ligament that has been damaged and this can only occur if the detached particle of bone becomes adherent to its normal bed. For this reason adequate immobilization must be prescribed and maintained until firm adherence is secured. Rarely nonunion occurs. Usually if the small particle of bone is in close approximation with its bed and has a firm fibrous union, the restitution of the normal tension of the detached relaxed ligament will be reasonably complete.

Fracture-dislocations occur most frequently around two joints that morphologically are closely similar that is the ankle and wrist joints. The external malleolus, the ulnar styloid, the radial styloid and the internal malleolus are involved in that order of frequency.

Fracture-sprains of the external malleolus are more common than generally supposed. Unless good detailed x ray films are obtained of sprained ankles their presence is frequently overlooked. The clinical picture appears to be that of a simple sprain. All fracture-sprains show marked soft tissue swelling with tenderness on pressure directly over the ligament which has been relaxed. The associated swelling due to a combination of serous exudate and hematoma formation deceives the examining physician. Unless care is taken to palpate carefully the bony prominence in the area of the sprain the point of localized tenderness over the bony attachment of the ligament is frequently overlooked. A point of localized tenderness to the bone proper at the attachment of the ligament is almost pathognomonic of fracture-sprains. This should put the examining physician on his guard and careful x ray films should be used to confirm the diagnosis.

The treatment of fracture-sprains is immobilization in an overcorrected position of the injured joint. In fracture-sprains of the external malleolus of the ankle the foot must be placed in eversion. In those of the internal malleolus the foot must be immobilized in marked inversion. In fracture-sprains of the ulnar styloid the wrist should be placed in marked ulnar deviation and in those of the radial styloid the wrist should be placed in marked radial deviation. A firm fitting circular cast is to be recommended in all of these cases.

For bony reattachment of the avulsed particle of bone, sufficient time must be permitted for beginning good bony union. This by necessity will require six to eight weeks of immobilization.

The prognosis in these cases is excellent. Only in neglected fracture-sprains does one ultimately have disability in the form of pain or instability of an articulation.



**Subperiosteal Fractures.**—These are a group of fractures which are linear in type without any displacement of the bone whatsoever and with no tearing of the periosteum. Frequently only one side of the tubular bone has been fractured. This type of fracture is seen most commonly in five locations: the radius, ulna, upper end of the humerus, tibia and fibula (see Fig 70).

Subperiosteal fracture occurs from either a direct trauma or a torsion trauma to a long bone which has expended its force immediately at the time that the cortex of the bone becomes disrupted. This by necessity must be a rather momentary force of not too great violence.

In the radius this type of fracture usually occurs either in the central portion of its shaft or in the distal three quarters to  $1\frac{1}{2}$  inch

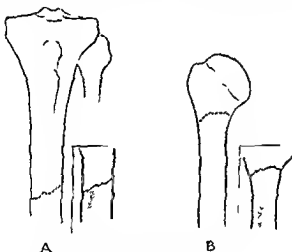


Fig 70—Subperiosteal fracture

above the carpal articulation. In the ulna it is most common in the middle third of the shaft. Only in rare instances is it found at either the olecranon process or the bulbous end of the ulna at the wrist joint.

The humerus is a long bone with many muscular attachments and a rather thick cortex in its shaft, thus subperiosteal fracture occurs in it only in the cancellous portion of the bone in the area of the surgical neck. The fracture is seen most frequently in children and in the elderly. The bone in children is relatively soft and pliable because of the immature bone growth, and in the elderly it is fragile, due to the osteoporosis of senility. Only with good x ray films does

haps in some instances the use of a sling. Even in young children nothing more than a sling is usually necessary because the child soon learns that activity of any magnitude produces pain and discomfort in the shoulder and he will in self protection avoid this extra pain. However if the child is unusually difficult to handle or is exceptionally active immobilization to the chest might well be carried out without any great expense or discomfort to the patient. After ten to fourteen days no further immobilization is required in children.

Linear subperiosteal fractures of the tibia are occasionally seen in children but rarely in adults who have normal cortical bone development. All that is required in these cases is adequate immobilization and no weight bearing until such time as the x rays show a solid bony union. In children this always occurs. In adults on certain rare occasions osteoporosis along the fracture line with absorption of the calcium progresses to such an extent that the fracture line is markedly visible roentgenographically six or eight weeks after the fracture although it was scarcely visible at the time of the original x ray study immediately after the accident. The clinical explanation of this phenomenon is none too clear. I have seen several cases of this type which have gone on to actual nonunion requiring surgery for the reestablishment of solid continuity of bone. This of course is a rare complication.

Subperiosteal linear fracture frequently occurs in the lower end of the fibula just above the external malleolus with absolutely no displacement. This type of case is often treated as a sprain and goes on to a happy termination and only when x ray films have been taken does one find evidence of the linear fracture. For the best end results immobilization is indicated and will reduce the pain and associated swelling and fibrosis about the joint. The use of a walking iron is most satisfactory and does not greatly incapacitate the patient.

Linear fractures of the upper end of the fibula usually occur from direct violence such as the bumping of the leg by an automobile fender or the striking of the extremity against a piece of machinery. There is usually an associated soft tissue trauma which produces swelling and obliteration of details. The swelling makes it difficult to localize the pain directly over the bone. For this reason it is not too difficult to overlook this type of fracture. Fortunately the fracture is in a portion of the bone that is not associated with actual weight bearing and consequently causes little disability and rarely any definite pain or discomfort on walking. Persons who have the average pain tolerance get along very well with this type of fracture with no immobilization whatsoever. In patients with a low pain tolerance or those who have a tendency to be slightly hysterical or maladjusted immobilization of the knee joint might be advisable until such time as the continuity of the bone trabeculations is restored in the region of the fracture.

## MINOR SURGERY OF THE FOOT

JAMES K. STACK, M.D., F.A.C.S.\*

### AFFECTIONS OF THE NAILS

**Ingrown Toenail.**—In childhood and the teen age the most common affection of the toenails is of the medial aspect of the great toe. This affection is almost invariably due to the pressure of a malfitting shoe or short sock. The fleshy part of the medial surface is compressed so that the medial corner of the nail in its growth will perforate the epithelium and set up a low grade infection. The onset is usually followed by the appearance of a small, red, tender area on the medial aspect of the toe.

this stage that minor surgical procedures will be effective. We hesitate to make a radical excision of the medial border of the nail and its matrix in a child, because there is no need to narrow the nail permanently, and frequently the matrix will not be completely destroyed and little spurs of nail will grow through the scar in its proximal portion. A simple excision of the corner or border of the nail or, if necessary, the removal of the entire nail without destruction of the matrix, will suffice. This can then be followed by training of the new nail as it grows out and instruction to the parents as to the proper type of wide toe shoe and the need for adequate length in the stocking.

This type of nail affliction was seen with great frequency in the armed services and was, of course, due to the aforementioned factors plus careless or improper foot hygiene.

In the adult it is quite a different story. The nail is no longer flat but tends to form an inverted "U" so that growth and perforation occur of the results readily.

done under local anesthesia, obtained either by direct infiltration of the end and side of the toe or by a block of the digital nerves at the

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base of the toe. A rubber band tourniquet or a twisted gauze dressing with a hemostat will give a suitable bloodless field, so that the edges of the nail bed and matrix can be visualized and completely removed. Following the healing phase, the patient should be cautioned to train the corners of the new nail to grow flat, and when trimming the nail to cut only straight across. Small wisps of cotton tucked under the nail corner with a toothpick, knife blade or hairpin will keep it elevated during the training period.

**Dorsal Hypertrophy; Horn Formation.**—Another common affliction of the nail in adult life, particularly in the more advanced decades, is hypertrophy and piling up of the dorsum of the nail. It then has a tendency to make inroads on the flesh of both sides, so that in looking at it from the end of the toe it forms an inverted "U" or may even be horseshoe shaped with a circular mass of skin within it. Many such nails are the result of a true fungus involvement, but many more are simply growth abnormalities, the basis of which has not been firmly established. These patients will complain of the actual bulk of the nail pressing against the top of the shoe, and this pressure will in turn be referred down along the circular edges, giving pain on each side. They can be helped a good deal by shaving or filing the top of the nail flat, so that regrowth is concentrated on the dorsal surface rather than on the surfaces making up the arms of the horseshoe. Also, the flat surface will be subjected to less pressure and subsequently cause less pain.

In extreme instances of actual horn formation the nails must be cut with a rongeur or bone-biting forceps, or they will have to be removed with the hope that the new nail will have less tendency to overgrowth. In these cases chitinous debris will usually be found beneath the distal portion of the nail and this should be removed with an orange stick or cotton as part of the daily care. The application of cold cream to the cuticle and the surrounding skin will keep these structures soft and enable them to better withstand the pressure exerted on them throughout the day by the nail itself.

These same lesions may occur in the nails of other toes, but seldom with the same frequency or with the same degree of irritation. There is no essential difference, however, between the treatment of nail abnormalities of the great toe and any other toe that might be involved.

**Subungual Lesions.**—The subungual space is frequently the site of painful and potentially serious lesions. The commonest is the *subungual hematoma* which is a collection of blood due to rupture of the vessels of the nail bed. The blood then creates considerable tension within the closed space and produces a severe throbbing pain. This lesion is the result, as might be expected, of falling objects striking the nail. Relief is immediate when the hematoma is evacuated by drill hole or slit in the softer proximal portion of the nail over the

lunula. Simple sterile precautions will suffice as after-care, but loss or deformity of the nail is usually to be expected. It is better to leave in place for as long as possible a nail which is going to be lost, to afford protection for the nail bed during the substitution period.

*Subungual exostoses* are benign bony outgrowths of the dorsal surface of the distal phalanx and can be the cause of deformity and discomfort. The diagnosis is confirmed by x ray and the treatment is removal of the growth after the nail has been removed. Recurrences are not to be expected and, if the matrix is not damaged in the process, a new and normal nail should develop. *Subungual abscesses* can be the result of infected hematomas, neglected paronychia, or a rupture into the subungual space of an osteomyelitic lesion of the phalanx. They are treated by simple evacuation or evacuation plus appropriate treatment of the underlying cause. *Subungual glomus tumors* are rare, but when they do occur there is no affliction that is more painful. These are a combination of tissues appropriately named neuro myo arterial glomus and they have a predilection for the extremities. Diagnosis is based on the exquisite and constant trigger area of tenderness and the purplish discoloration. Their complete excision is followed by relief.

like wildfire and death by metastases may take place before the local primary lesion assumes an aspect of importance or urgency. Suspicion is aroused by brown pigmentation, ulceration and failure to respond to simple treatment. Biopsy is dangerous.

#### AFFECTIONS OF THE GREAT TOE

The great toe, because of its importance in foot posture and gait, is the site of more complaints than any of the other pedal digits.

**Bunions and Hallux Valgus**—Aside from the affections of the nails, previously mentioned, the most common lesion of the great toe is the bunion. Unfortunately, bunions are taken too lightly by many of us

medial aspect of the first metatarsal head. Such inflammation may take place, however, unless a suitable groundwork has been laid. Any reasonably well fitting shoe will not in itself cause enough pressure

The most common underlying cause, particularly in young people, is a *metatarsus primus varus deformity*. This is congenital and is characterized by a medial deviation of the first metatarsal bone and

the formation of an acute angle between this bone and the cuneiform with which it articulates. The great toe then when subjected to the pressure of even a properly fitting shoe can do nothing but deviate in the lateral direction or the patient would never be able to get a shoe on due to the extreme width of the foot at the distal end of the metatarsals. The great toe then assumes this position of hallux valgus and the prominence on the medial side of the head of the first metatarsal then becomes subjected to pressure which in turn will cause the bunion formation. Narrow or pointed shoes or short stockings can produce a hallux valgus and bunion formation without serious deformity of the first metatarsal and this frequently happens in older people. The child or adolescent however will invariably have all three of the factors mentioned.

As time goes on virtual partial lateral dislocation occurs at the first metatarsophalangeal joint and enlargement and prominence will occur medially. Only a portion of the articular surface of the first metatarsal will be used in the function of this point. Traumatic arthritic changes invariably take place and a bony ridge will develop particularly on the dorsal surface. This dorsal ridging produces a limitation of dorsiflexion of the great toe with the result that the patient is forced to toe out in order to take a step of normal length. Such a gait as can be readily visualized will increase the forces that are producing the deformity and will lead to the development of calluses on the medial plantar surface of the great toe. Splaying of the forefoot and innumerable static difficulties will then arise as the result of these disturbances in this very important joint. X rays should always be taken in order to ascertain the degree of arthritic change and the presence or absence of smaller exostoses on the phalanges of the other toes due to pressure and to determine the state and position of the two sesamoids that are situated beneath the first metatarsal head.

**Treatment**—In the conservative management of hallux valgus one attempts to alleviate the valgoplanus that so frequently accompanies it and to restore in so far as possible a normal gait. Every effort to correct the condition by

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 case of young patients  
 is doubtful whether no

cessful over a long period of time. The problem is of course greater in women because of the difficulty in making proper correction on shoes they are willing to wear. An attempt should be made by elevation of the medial margin of the heel to bring the hind foot into varus and then by means of a metatarsal bar to bring the forefoot into a position of pronation. The term "pronated foot" is in one respect misleading in that the forefoot is not pronated but actually supinated and better weight distribution can occur only by having the proper correction of the forefoot in mind.

The operative management of bunions does not properly come under the heading of minor surgery of the foot. It is similar in this respect to the surgical management of hernias and hemorrhoids, because these three fields are notable for not only the poor, but the many downright harmful results that may come of ill advised surgical procedures. There are literally dozens of operations advocated for the relief of bunion pain and deformity, and I will speak only of the few that are used in this clinic with what we consider reasonable success. No operation is done routinely on all patients, the procedure is chosen to fit the patient, and not the converse.

In the adolescent patient not only should the medial exostosis be removed, but an osteotomy at the metatarsocuneiform joint should be done according to the method of Lapidus. Section of the lateral capsule of the metatarsophalangeal joint, imbrication of the medial, tendon transplant and so forth may or may not be done, according to the needs of the particular situation. It will be found in this group of patients that the restoration of the first metatarsal bone to alignment nearly parallel with the second, and the establishment of proper relaxation of the proximal phalanx on the first metatarsal will, when coupled with proper follow-up care, produce a good result. In older patients with arthritic changes we do not as a rule perform the Lapidus osteotomy but rather confine our efforts to the removal of the exostoses over all areas of the head, plus the Keller procedure. The Keller procedure is the most useful of the techniques, by and large,

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#### AFFECTIONS OF THE SECOND TOE

It is a common observation that in many persons the second toe is longer than the great toe. As a result it is frequently injured in stubbing accidents and frequently deformed by short shoes or stockings.

**Fractures and Dislocations.**—Fractures of the second toe are treated in the same manner as in the others, namely, by splinting, restriction of weight bearing, and skin, nail or skeletal traction if nec-

position of overriding on the head of the metatarsal, and patients are not always willing to undergo the long period of immobilization necessary to permit the joint capsule to heal. The toe must be held in a position of strong flexion to overcome the tendency to dorsal displacement, and it will require from three to six weeks to heal. After healing has been effected, metatarsal pads should be used to keep the metatarsal head up, and in this way cause the toe to remain in a position of partial flexion. Many of these second joint dislocations are neglected and, in the case of old dislocation, repair of the capsule of the joint with maintenance of the flexion position is not likely to hold.

We believe that the Keller procedure, that is, excision of the proximal half of the phalanx, is the best method of dealing with the neglected dislocation and, if the head of the metatarsal is prolapsed, as it frequently is, and gives painful symptoms on the sole, an exostectomy of the plantar surface of the metatarsal head may be added to the Keller procedure. In all cases of long standing hallux valgus this joint should be examined for dislocation.

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This syndactylism is usually not bony, but involves simply the skin and periosteal tissues.

**Hammer Toe.**—A hammer toe is one in which the proximal phalanx of the toe is fixed in a position of extension and the other phalanges are fixed in a position of flexion. This results in a painful shoe pressure or friction area on the dorsal surface of the distal end of the proximal phalanx, and since the contracture does away with the normal distribution and gripping action of the toe during weight bearing, painful areas may also develop on the plantar surface of the tip of the toe. One can conceive of this as being due to the absence of the normal resiliency of the toe, which is literally squeezed between the ground and the top of the shoe. Hammer toe occurs as a rule in the second, third and fourth toes spontaneously, but seldom occurs in the great toe unless an injury or surgical procedure has interfered with the flexion mechanism of the proximal phalanx.

Our choice of operation in the usual hammer toe is excision and fusion of the proximal interphalangeal joint. This is followed by tenotomy and capsulotomy on the dorsal surface of the metatarsophalangeal joint. The fusion may be accomplished by the use of the bone (the proximal phalanx of the second toe) as a graft, or the position of the proximal phalanx during the fusion may be maintained by a wire or suture passing down and getting a fix in the remaining portion of the proximal phalanx. Others may recommend a simple excision of the prominent portion of the distal end of the proximal phalanx, and this method requires much less time than the fusion method. It



does away with the deformity and with the pressure or friction dorsal area but leaves a flail joint. A single flail joint is not undesirable but to treat three hammer toes by joint excision alone would certainly weaken the gripping action of the toes during the step. In the case of multiple hammer contracted toes then it is better to follow the excision by fusion and section of the dorsal tendon and capsule.

### AFFECTIONS OF THE FIFTH TOE

**Congenital Dorsal Displacement**—A congenital dorsal displace-

mentally and override the fourth toe and this will of course be followed by corns, calluses or actual ulceration. It will be found on examination both clinical and x ray that there is an actual dorsal dislocation of this toe and plastic procedures designed to restore it to normal position and function will probably not be successful. The

of all the toes and it is our practice to do the necessary plastic or fusion procedures on the second, third and fourth toes while at the same time amputating the fifth. A good point to remember concerning amputation of the fifth toe is that the lateral prominence of the metatarsal head may give trouble when the toe is absent. One can visualize that without the toe the lateral aspect of the metatarsal head will be subjected to undue pressure from the side. Therefore a lateral exostectomy should be done in connection with the fifth toe amputation. The metatarsal head should not be excised.

**Tailor's Bunion**—The so-called bunionette or tailor's bunion is the most common of acquired lesions of the fifth toe. It consists of the gradual development of an exostosis and inflamed bursa over the lateral surface of the metatarsal head. A simple lateral exostectomy will suffice to cure the condition.

**Corns and Calluses**—Nearly all women, or so it seems, have either a corn or a callus on the fifth toe. This would be a good place to mention that in our work we see probably one man with a painful foot.

The cause of course a problem of shoes

seen on the lateral surface of developed to reinforce the skin structures from the pressure never of the imposition of this the bone is being irritated

and an exostosis gradually forms on the lateral side of the interphalangeal joint surface. If the pressure is relieved by wearing properly fitting pads or a wider shoe symptoms will subside and the exostosis

may become less sharp or be actually absorbed. If the pressure is retained then cure can be brought about only by removal of the exostosis. This is done by a short flap type of incision with the convexity dorsalward. The flap is reflected, the exostosis chiselled off and the incision closed. The corn or callus will then gradually soften and disappear of its own accord because of absence of any demand for its presence. Recurrence will follow the resumption of the original pressure.

The so called interdigital or *soft corns* are produced by the same mechanism. They may contain a small adventitious bursa; if they do not their softness can be attributed to the moisture and maceration of skin so commonly present in the interdigital area. Treatment is exactly the same—protection from pressure under shoes or if necessary excision of the exostosis which will be followed by gradual disappearance of the skin manifestations.

### AFFECTIONS OF THE PLANTAR SURFACE

**Plantar Wart**—The most common of the painful lesions of the plantar surface of the foot is the plantar wart. While theoretically this may occur on any part of the foot it usually occurs in or near pressure points. I have never seen one beneath the longitudinal arch nor have I seen any along the lateral margin of the weight bearing surface. A few will occur on the heel but most will occur in the region between the metatarsal heads and the web of the toes. They must be differentiated from meluena with overlying callus and from the ordinary pressure keratosis. Most plantar warts are exquisitely tender not only on direct pressure as in walking or pushing with the finger but on squeezing them from side to side. The fact that they occur so frequently in the area distal to the metatarsal heads an area which is not subjected to the pressure of bony prominences underneath suggests that they are true new growths and not solely a response to pressure or friction. Some of the tenderness will be relieved by treating the callus overlying them and they may be helped for an indefinite time by pads designed to minimize the pressure on them but usually they will not be eradicated until they are destroyed by chemical surgical or radiation treatment. Those that are actually cured by simpler means such as the application of salves padding of shoes and the like are probably not true intracutaneous papillomas but rather bursae or pressure keratotic areas. Such simple measures may be helpful however in the differential diagnosis and can be tried safely for many weeks.

For the refractory case we favor the application of radium by those qualified to use this method. An accurate record of the dosage of either radium or x ray applied to these lesions should be kept by the patient because he may not get a successful result at first and in wandering from place to place repetitious treatment could cause a

radiation burn with disabling ulceration. In the event of failure of radium treatment, or recurrence following initial success, excision should be considered. We do not consider excision as the primary method of treatment because we do not like to make an incision on the plantar surface of the foot. The incision should be carefully outlined so that not only skin but also a good layer of subcutaneous tissue will be available to cover the defect. In the case of a small defect, simple undermining and suture may suffice, but in the larger defect flaps may have to be transferred. In still others, particularly those with ulceration, the toe immediately above the lesion may have to be sacrificed and used without its bone as a pedicle flap.

**Painful Heel**—Another common and disabling lesion of the plantar surface of the foot is the painful heel, commonly caused by an os calcis spur and called by the older writers "policeman's heel." The patient will usually complain of the insidious onset of pain over the anterior surface of the pressure area of the heel. There will be no gross swelling or redness on inspection, but there will be tenderness, sometimes exquisite, over the plantar surface of the heel at the point of attachment of the plantar fascia. The symptoms will vary. Some patients will say that they are comfortable at rest, but that after sitting for a long period the first dozen steps or so will be very painful and then, as activity is increased, the pain will become less and less.

calcis growing parallel along and into the shadow of the plantar fascia. This will correspond with the point of maximal tenderness and it will also correspond well with the fact that the tenderness is greater when the foot is placed in a position of strong dorsiflexion at the time pressure is applied. There is less tenderness when the foot is in plantar

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it is not made of porous immature bone of presumably recent formation, but is dense and every bit as mature looking as the parent bone from which it arises. One then should reason that since the presence of the spur antedates by many months or years the onset of pain, some other factor has been superimposed. What is this other factor? We believe that nature has developed over this spur an adventitious bursa, and the onset of pain coincides with the development of inflammation of the bursa. The factors producing this inflammation may be pressure or a new shoe or some minute prominence in the heel of

"stone bruise" or some systemic  
such as gout

a painful heel will do well if the

heel is protected with a horseshoe type of sponge rubber pad glued to the inside of the shoe so that the weight will be taken on the periphery of the heel and not over the painful area. If gout can be established, or if reasonable foci of infection can be eradicated, then appropriate measures may be taken which, with the restriction of pressure, will produce a cure.

In the follow up of such a case it will be found that after the patient has made a complete recovery the spur is still present. When one is tempted to operate on such a heel and remove the spur, he should consider that spurs growing into tendons and into fascia are common throughout the body. They are seen growing into the Achilles tendon on the superior and posterior surface of the heel. They are seen growing out of the superior and inferior surfaces of the patella and from the superior surface of the olecranon and seldom if ever are they the real cause of difficulty in or around the joints they involve. I have never removed an ordinary os calcis spur because I have never considered them the basic difficulty. When contemplating the surgical removal of such a spur one must remember that he is dealing with cancellous bone of great regenerative power and a new and larger exostosis could be the result.



## MINOR UROLOGICAL SURGERY

JOSEPH H. KILFER, M.D.\*

*This presentation is not intended to cover in a complete and detailed manner all the subjects which might be included under this title. It is meant rather to discuss some of the conditions commonly encountered in the general practice of medicine which are properly described as minor urologic procedures and to mention and emphasize those points which seem to be most important and most helpful.*

*This discussion will not include urethroscopic or cystoscopic examinations or manipulations or conditions requiring such procedures since these require special instruments and special training.*

### KIDNEY

**Perinephric Abscess**—Surgery of the kidney is major surgery with few exceptions. These are cases in which a perinephric abscess is pointing through the lumbar triangle. Perinephric abscess may burrow downwards along the retroperitoneal space towards the pelvis or may penetrate the diaphragm causing an empyema. Fortunately more often if untreated it will point through the lumbar triangle.

The other diagnostic signs of perinephric abscess will usually be present. These are fullness to palpation, tenderness, muscle spasm and of course the accompanying general signs of fever and leukocytosis.

X-ray evidence may be present and consists of scoliosis, loss of the normal kidney and psoas muscle outlines and fixation of the kidney. This fixation may be determined by intravenous or retrograde urography by taking films both in the recumbent and upright positions. Normally the kidney shifts from 1 to 5 cm. on change from the recumbent to the upright position. Lack of this normal motion is an indication of abnormal fixation which may be due to inflammatory adhesions. Displacement of the kidney as evidenced by displacement of the pyelographic shadow may also be present. Sometimes a lateral anteroposterior plane which is

necessary only in the obscure image and exploration in such cases is of course a major surgical problem. The case in which drain

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age can be effected by a minor surgical procedure will usually be quite obvious on physical examination with bulging in the area of the lumbar triangle. In such a case incision and drainage may be done with a minimum of equipment. The incision is made in an oblique line paralleling the course of the intercostal vessels and nerves. No case in which a renal or perirenal exploration is necessary should be treated as a minor case. In most instances of perinephric abscess there is some kidney disease which is the cause of the perinephritis. Often however the severe illness of the patient will make a primary incision and drainage such as has been discussed advisable with exploration deferred to a later date.

There are no minor surgical procedures on the ureter which are not endoscopic in nature. The same is true of most bladder conditions.

### BLADDER

**Acute Urinary Retention**—Acute urinary retention is one of the conditions in medicine which calls for emergency treatment. Every practitioner of medicine knows the marked distress of the patient who cannot void and he must be able to give some relief. Acute urinary retention falls into several groups according to the etiologic factor. There is a group in which the inability is reflex or neurologic. In this group are the postoperative patients who have had pelvic operations or hemorrhaphy and have a reflex retention. The true neurologic group is made up of those who have had a nerve or spinal disease or injury. Then we have the group in which there is mechanical obstruction either urethral stricture or enlargement of the prostate.

Before attempting catheterization it is well to try and determine in which group the patient belongs. The postoperative reflex retention is usually easily identified as is the group due to nerve injury. The group with urethral stricture will frequently give a definite story of gradual slowing of the stream and may give a story of previous soundings and catheterizations. The individuals in this group may be young or old. The men with prostatic enlargement are usually in the older age group with a history of gradually increasing urinary difficulty. A diagnosis of prostatic enlargement can often be confirmed by rectal examination.

The treatment in any case is catheterization whenever this is possible.

**Catheterization**—Catheterization should be done as aseptically as possible. Any care directed towards asepsis and lack of trauma will be more than repaid in absence of later difficulties and complications particularly that of infection. The patient with an obstructed and overdistended bladder is perfectly prepared for the beginnings of a severe urinary tract infection. It is only by care and close attention that such complications may be avoided. The direct introduction of infection through dirty instruments or poor technic will frequently

start such infection. Trauma due to rough handling and instrumentation will increase the incidence and severity of any such infections which may follow.

Where catheterization cannot be done at once the patient should be placed in a hot hip or Sitz bath. He should be cautioned to refrain as much as possible from voluntary straining and pushing. A sedative, preferably morphine, should be given. Under such circumstances some of the sphincter spasm may be relaxed and partial relief afforded. In postoperative reflex retention the patient cannot usually be placed in a tub. In this case a warm external douche, or the application of a large towel wrung out of hot water, may serve the same purpose.

The first attempt at catheterization should be made with a rather small catheter, about 14 F., of moderately firm consistency not too

roughly washed with soap and water. This soap and water preparation is much more important than the use of any antiseptic or germicidal solution. A generous amount of water soluble lubricant (either glycerin or sterile jelly) should be used. The urethra should be stretched out to its full length to remove the pocket which normally

another attempt made. However, forceful or protracted attempts should not be made as they only lead to trauma with further edema which increases the difficulty.

If the catheter is obstructed in the anterior urethra it is probable that the obstruction is due to a stricture. If the catheter passes through the anterior urethra but is obstructed at the prostatic portion it is

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passage of the catheter. Sufficiently to relieve the acute retention. Sometimes a ureteral catheter may be passed where it is impossible to pass any soft rubber catheter. A Coudé or elbowed catheter is most useful if the obstruction is

prostatic in origin. If even the elbowed catheter will not pass through the prostatic urethra, it may help to have some one place a finger in the rectum and raise up the point of the catheter in the membranous and prostatic urethra. At times this will enable a catheter to pass that otherwise would not. This maneuver may be helpful even with plain catheters where Coudé catheters are not available. Mandrins or catheter stylets should be used with great care and only with hollow tip catheters and by those who have had experience in passing rigid instruments. The same is true of metal catheters.

*Suprapubic Puncture*—If all such attempts at catheterization through the urethra fail, it is necessary to drain the bladder by other means. If the patient is not near a hospital, it is possible to drain the overdistended bladder by suprapubic insertion of a long needle such as a spinal puncture needle. This is done without difficulty when the bladder is distended. Procaine infiltration may be used but is not necessary. The needle is inserted in the midline about 2 to 3 cc above the symphysis pubis. As the urine flows out or is aspirated, the bladder collapses and one may have to gradually twist or move the needle as the bladder becomes empty and the mucosa falls against the needle opening. Finally the needle is slowly withdrawn. In this way most of the bladder contents can be removed. There is little or no danger connected with this procedure if the urine is not infected. If infection is present, such a procedure may be followed by inflammation of the perivesical tissues, which would then require special surgical drainage.

A more complicated form of suprapubic puncture can be done with a trocar. The skin is infiltrated with procaine in the midline about 3 cc above the symphysis. A small incision is made through the skin and then through the rectus fascia. The trocar, which should be large enough to contain a 20 F catheter, is then introduced into the bladder but the urine is not immediately drained off. A straight catheter of the largest size which the trocar will admit or a Malecot (winged) catheter stretched on a straight stylet is then introduced through the trocar as soon as the obturator is withdrawn. The trocar can then be withdrawn over the catheter, leaving the end of the catheter in the bladder. This allows continuous suprapubic drainage until the emergency is over and proper procedures can be instituted to correct the pathologic condition. There are some special trocars made for this purpose but they are not essential.

*Suprapubic cystostomy* may be done on the overdistended bladder with a very small incision instead of the trocar puncture above described. Usually, however, if the physician is not well acquainted

*Injuries to the Bladder*—The repair of bladder injuries is a major surgical procedure. However, it is important to establish the pres



ence or absence of bladder injury whenever there has been severe trauma to the abdomen or pelvic girdle. The symptoms may be unimpressive and in some cases the patient's general condition does not allow close questioning. Every patient with a fracture of the pelvis should be suspected of possible bladder injury. If the patient can void normally and passes a clear urine, it is unlikely that bladder injury is present. If the patient has urethral bleeding, passes bloody urine or cannot void at all, there is immediate suspicion of such injury and further steps must be taken to prove or disprove the presence of injury.

Any diagnostic procedures should await the transportation of the injured person to a hospital where strict aseptic precautions can be adhered to. Intravenous urography may be helpful if the patient is not in shock. Where the patient is in a state of shock, the kidney function may be so depressed that not enough dye is secreted to properly outline the urinary passages. If the urinary passages are well outlined, it may be possible to see extravasation of dye outside the normal areas, or the normal areas may show up well enough to rule out the presence of an injury. Such x ray may show injury of the kidney or ureter as well as of the lower urinary tract and is very helpful from this standpoint as well.

The bladder normally appears having an oval symmetric outline with its upper border sometimes depressed in females by the fundus of the uterus. The finding of an irregular outline is very suggestive. Irregular extravasation of dye anywhere outside the normal boundaries of the urinary tract may indicate presence of a break in the continuity of the urinary passages.

Bladder or urethral injury may be further detected by passing a catheter through the urethra. If the patient is asked to void and can not do so easily, he should not be urged to try to expel urine forcefully since if there is a break in the continuity of the urethra or a small tear in the bladder wall, the urine under such circumstances may be forced into the cellular tissues, thus making a bad condition worse.

The passage of a catheter should be done with strict precautions since if there is a rupture of the bladder, the introduction of infection will make the condition much more serious. A small soft rubber catheter should be used and with the utmost gentleness. If it will not pass easily, it is best to secure expert urologic help. Any other instrumentation should be done only if a full and complete repair can follow.

likewise arouse suspicion because the urine can accumulate in the peritoneal cavity. Under such circumstances there will be signs of

peritoneal irritation. It is not wise to inject fluids through the catheter unless one is prepared immediately to do a laparotomy if necessary.

Under such circumstances one may inject air through the catheter (the Rudnick-Vaughan test) and do a fluoroscopic or x-ray examination. If the bladder is intact the air bubble will appear as an oval symmetric shadow in the normal position of the bladder. If there has been intraperitoneal rupture the air will appear under the diaphragm or in the flanks if the patient is placed in the upright or lateral position. If there is an extraperitoneal rupture the air will appear as an irregular shadow in the pelvic region.

The inability to pass the catheter at all usually indicates urethral injury. If the obstruction is anterior to the membranous urethra it must be repaired by a perineal approach while if the obstruction is above the membranous urethra the suprapubic approach must be used. Repair by either approach is a major surgical operation requiring the services of a urologist whenever possible.

### URETHRA

**Stricture of the Urethral Meatus**—A rather common congenital condition which calls for treatment is stricture of the urethral meatus. This may be a cause of definite obstruction especially if the orifice is of pin point size in which case it can even result in hydronephrosis and uremia. More commonly the obstruction to the urinary stream is slight and the cause of only mild discomfort. Such a condition will be made much worse by any complicating infection and may be a cause of chronicity in urethral infections. The treatment is meatotomy or incision of the meatus. Dilatations are unsuccessful because the skin will not dilate but will merely tear.

**Meatotomy**—The incision is made on the ventral side. It is better to cut the meatus wider than the end result desired since there is a tendency for the incised edges to grow together. This can be prevented in most cases by suturing the mucosa and skin edges together at the depth of the incision. In small children this is not always easy and it may be well to place a stitch before making the incision. The meatus should be spread every day thereafter to prevent agglutination of the raw surfaces. A small petrolatum dressing also helps. Meatotomy may also be necessary in the adult and is done according to the same principles.

**Urethral Stricture**—Urethral stricture is fortunately not now as common as it was in the past owing to the better treatment of urethritis. However both inflammatory and traumatic strictures are still seen. The diagnosis is made by calibration of the urethra with graduated sizes of urethral sounds or diagnostic bulb bougies. The best treatment is still *gradual dilatation* with smooth tapered sounds or bougies. The dilatation should be as gentle as possible with every effort to avoid tearing of the mucosa or of the periurethral structures.

Following this plan it may take many months to dilate the stricture to full size. However, such time is well spent. If rapid contraction of a stricture makes a plan of gradual dilatation unworkable, urethrotomy may be necessary. This is a highly technical procedure and should be considered major surgery. Again it should be mentioned that the strictures of the meatus cannot be dilated and must be cut.

**Periurethral Abscess**—Infections of the urethra are sometimes complicated by abscesses arising in the periurethral tissues as a result of infection of the various periurethral glands. If these occur close to the meatus or in the penile urethra it is best to incise them from the urethral side whenever possible. This avoids the possibility of fistula which otherwise commonly follows incision through the skin. There are times when an incision through the skin cannot be avoided.

Periurethral abscess in the perineum and region of the bulbous urethra may be opened through the skin with less danger of fistula formation due to the relatively thicker tissues intervening between the urethra and the skin. A good many of these perineal abscesses are followed by urethral fistula, the chief reason being that the original periurethral infection was the result of a stricture and unless the stricture is also treated by dilatation, a perineal fistula is likely to persist.

**Injuries of the Urethra**—Injuries of the urethra are of three chief varieties. Tears or ruptures of the membranous urethra are most com-

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of the bladder. Operative repair in these cases is a major procedure which requires suprapubic approach to the bladder, realignment of the urethral segment, placement of a splinting catheter and diversion of the urine.

The second variety of urethral injury is the so called *straddle injury*. The urethra is traumatized in varying degrees from simple mild

of the urethra

swelling in the perineum and a varying degree of interference with urination. The catheter will usually be obstructed in the region of the injury. If the patient can void easily no treatment other than pressure dressings over the injured area is necessary. This is to prevent further oozing of blood and hematoma formation. Pressure should be released only when the patient voids. If the patient cannot void easily he

should not force his urine. An attempt might be made under the best aseptic precautions to pass a small catheter into the bladder. If this is unsuccessful the problem becomes a major one requiring perineal incision for release of blood clot and repair of the urethra with diversion of the urine either by a perineal catheter or by suprapubic cystotomy.

A third type of injury is *laceration of the penile urethra by penetration*. This is usually associated with injury of the penis and will be taken up under that heading.

**Urethral Stones**—Occasionally stones will pass from the bladder into the urethra and there become impacted. The patient will usually be able to make the diagnosis himself since he will have an obstruction to urination and can usually feel the hard object in the urethra. Fortunately the most common point of obstruction is just behind the meatus. Many of these stones can be removed with a fine forceps after injecting some lubricant material or after meatotomy with the necessary anesthesia. If removal is not possible incision through the skin may be necessary in which case the maneuver of sliding the skin as far as possible from its normal position so as to displace the line of incision should be used.

**Foreign Bodies in the Urethra**—Occasionally foreign bodies are inserted into the urethra by children of all ages. Practically every type of foreign body which it is mechanically possible to put into the urethra has had to be extracted at one time or another. In the female such foreign bodies owing to the shortness of the urethra usually pass on into the bladder and must be removed therefrom. In the male some of the foreign bodies slip into the bladder as well but many become lodged in the urethra. The usual story is that the object has slipped from the grasp of the inserter whether the patient or a companion. As might be expected the smooth end of the instrument is usually inserted first and when the object slips from the grasp frequently it cannot then be withdrawn. This is especially true of pins with round heads, glass rods and the like. These objects if left for more than a short time become encrusted and their removal becomes progressively more difficult. Chewing gum and wax if they slip into the bladder frequently become the nucleus for large bladder stones. If the object slips into the bladder of course the problem is a major one involving cystoscopic or suprapubic removal.

In the urethra some foreign bodies can be grasped with forceps and removed. Before any such attempt is made to grasp an object careful palpation should determine where the object is located and then the urethra is compressed proximal to that point to prevent pushing the object back into the bladder during the manipulation necessary to

grasp it. If the object is



ner Care should be taken not to promise or expect such results since the cause of the symptoms in these cases is usually psychic rather than anatomic

Anesthesia for circumcision varies In the newborn frequently no anesthetic other than sedation is necessary In the child general anesthesia is always desirable For the adult local anesthesia is perfectly satisfactory or intravenous anesthesia may be used in the apprehensive patient Local anesthesia may be of three types Local infiltration of the foreskin is not so desirable because it deforms the tissues and increases the difficulty of the operation Adequate anesthesia can be secured by procaine infiltration at the base of the penis away from the field of the operation Within the last few years a method of anesthesia has been presented which consists in the injection of 10 cc of 1 per cent procaine into the vascular spaces of each of the corpora cavernosa

Regardless of the anesthesia the best all around technic is still to do a dorsal midline incision through the foreskin up to a point which will leave the desired amount of foreskin remaining An incision in the ventral midline is likewise made up to the frenulum By spreading out the foreskin the redundant tissue can then be excised with a scissors In the adult we feel that enough foreskin should be left to cover the corona of the glans If this is not done the rubbing of the glans on the clothing may cause considerable discomfort This does not occur when the circumcision is done in infancy since the individual becomes accustomed to the situation Hemostasis is secured by fine gut ligatures and the mucosa and skin edges approximated with interrupted sutures These may be of any material though a soft nonirritating material such as cotton is preferable A single layer of petrolatum gauze may be placed over the incision and then a light pressure dressing over it leaving the meatus free so that urination will not wet the dressing A small outer dressing of elastic bandage such as Ace bandage will help maintain steady uniform light pressure

Balanitis —The so called "dorsal slit" or dorsal incision of the foreskin is frequently indicated for exposure or drainage in cases where there is an underlying lesion This procedure is indicated in severe balanitis where the foreskin cannot easily be retracted or in any case in which the foreskin is so tight that it cannot be retracted the discharge

should be treated with irrigations or medication alone where the source of the infection cannot be entirely exposed Otherwise an early carcinoma may be allowed to advance from the point where it was easily removable to a state where it requires extensive surgery or is inoperable Fulguration of penile lesions is seldom necessary nowadays since the advent of the podophyl ointment above mentioned



manent damage because of the extreme mobility of the testis and the protective cremasteric reflex. There may be considerable swelling but it usually soon subsides. Such injuries should be treated by adequate support, bed rest and application of cold packs to keep swelling at a minimum. More severe injury with laceration of the scrotum will require repair according to the extent of the injury. At times such an injury will lead to bleeding into the tunica vaginalis with formation of a hematocele. If this is seen early before the blood has clotted, the fluid may be withdrawn through a needle. Usually, however, the blood clots and the mass becomes quite solid. Usually such hematoceles eventually absorb but the absorption takes a very long time.

Injury may also lead to formation of an acute hydrocele. If this becomes tense and causes pain, aspiration will reduce the coincident discomfort.

There was formerly much controversy as to whether trauma could cause tumor formation in the testis. It is now generally conceded that single trauma does not cause testis tumor but that it sometimes calls attention to a previously existing mass.

**Torsion of the Testicle**—This is an uncommon but dramatic condition in which the testis becomes twisted on the spermatic cord with resulting impairment of circulation. This occurs following physical effort but has been known to occur at rest as well. It is thought that the condition results not so much from trauma as from congenital factors such as looseness of the scrotal fascias which allows excessive mobility of the testis. The condition is immediately followed by severe pain and swelling of the testis and eventually of the surrounding scrotal tissues. If seen early it may be possible to identify the various structures such as the epididymis and determine any change from their normal position. Usually, however, the swelling is so great that no definite anatomic landmarks can be distinguished. The testis may be found in a higher position than normal due to the shortening of the cord which results from the twisting. In any case where torsion is suspected, manual reduction to the normal position may be tried. If unsuccessful, immediate surgical exposure and untwisting of the cord is indicated.

**Inflammatory Conditions**—*Orchitis* or inflammation of the testis itself is seldom found as an isolated lesion. Mumps orchitis and syphilis of the testicle (gumma) are the only lesions of this type seen with any frequency and even they are now uncommon. Inflammatory disease of the epididymis accompanied by inflammation of the testicle is however seen with great frequency.

*Gonorrheal epididymitis* is now seen less frequently owing to the marvelous results of treatment of gonorrheal urethritis by the sulfonamide drugs and antibiotics. When seen as a complication, the treatment of gonorrheal epididymitis is conservative that is with a sulfonamide, penicillin, streptomycin or fever therapy. It is almost unheard



of for a gonorrheal epididymitis to break down and require incision and drainage

*Nonspecific epididymitis* is still frequently met with as a complication of urethral instrumentation, catheterization or as an accompaniment or sequela of nonspecific prostatitis. The treatment in such cases depends on the organism involved and these cases usually respond to the sulfonamide drugs or antibiotics—penicillin in the case of a gram positive cocci and streptomycin for gram negative bacilli. Of course the treatment should also be directed to any preceding or

*method of applying heat and gives great relief of discomfort*

*Tuberculosis* also causes a specific form of epididymitis. The onset is typically slow but occasionally may be quite acute. The swelling gradually increases, not responding to the ordinary methods of treatment. Breakdown and abscess formation are more common and after rupture occurs the wound fails to heal and a sinus results with a chronic discharge of pus. In such cases it is frequently possible to feel the nodular thickening of the vas which accompanies this disease. The prostate may also be irregularly thickened and nodular.

Proof of the tuberculous nature of the condition is not always easy. The urine and prostatic discharge should be examined by smear culture or guinea pig inoculation. The presence of tuberculosis in the genital tract arouses suspicion of tuberculosis of the urinary tract and calls for complete investigation to rule out tuberculosis of the kidneys and bladder. The tuberculous epididymis should be removed since spontaneous healing is unusual. This is not a minor operation, however, if the testicle is to be preserved. Many urologists consider it

have to be done

**Hydrocele of the Tunica Vaginalis**—Probably the commonest swelling of the testicle is hydrocele of the tunica vaginalis. There are acute types which accompany inflammatory disease or trauma as already mentioned above. These usually subside when the causative condition is relieved. Occasionally the hydrocele persists for an indefinite period afterward.

A large number  
rence, at least as

stitute the group  
usually insidious and the swelling gradual. They cause comparatively little discomfort, usually only a dragging or aching sensation due to the excessive weight of the mass. The swelling is smooth, regular and

usually tense and elastic Transillumination allows passage of light through the fluid and usually the outline of the testis can be made out.

The fluid can be easily removed by *aspirating* with a syringe and needle with strict aseptic precautions This is a useful diagnostic procedure as it will then be possible to palpate the testis after removing the fluid and determine the presence of any abnormal masses or induration This is especially important in the case of a tumor with a surrounding hydrocele and should be done at once whenever there is suspicion of an underlying pathologic condition of the testis or epididymis

Aspiration may also be useful merely for symptomatic relief in the acute hydrocele accompanying infections and has been recommended in mumps orchitis for the same reason In the so called idiopathic hydrocele the fluid will usually re collect and after a variable period the hydrocele will attain its previous size There are two methods of dealing with such a condition One is the *injection of sclerosing solutions* into the tunica vaginalis This is very highly thought of by some men who have had excellent results therewith in selected cases It may require repeated injections and sometimes leads to considerable scarring and sclerosis without complete obliteration of the sac lumen

The most widely recommended and most certain procedure for recurring hydrocele is excision of the parietal layer of the tunica vaginalis—*hydrocelectomy* The operation is not difficult but requires close attention to several details the chief being complete removal of the parietal layer so as to leave no pockets in which fluid may re collect Hemostasis must be thorough so that hematoma formation does not occur Such may easily happen if there is much venous oozing since the scrotal tissues are very loose and will fill up with blood to an enormous size before sufficient pressure develops to stop hemorrhage For this reason a pressure bandage should always be applied immediately after the surgery

**Spermatocele.**—A spermatocele is a small sac or diverticulum of the seminal tract There are usually no symptoms other than the presence of a mass The mass is usually small tense and elastic and is felt to be separate from but adjoining the testis usually near the

tract if this is not done, there may be recurrence

**Biopsy of the Testis.**—Biopsy of the testis can easily be done and is useful in the diagnosis of pathologic conditions of the testis resulting in impaired fertility If examination of the semen reveals the number or condition of the sperm to be abnormal, the next step in complete diagnosis is biopsy of the testis Aspiration biopsy is recommended by some since a needle may be passed through many areas of the testis in an attempt to obtain enough material to enable some

evaluation of the spermatogenic function. This method gives no clue to structural characteristics but merely shows the presence or absence of sperm and their morphologic characteristics. A true biopsy may easily be obtained through a tiny incision under local anesthesia. The skin is stretched over the testicle and, after procaine infiltration a tiny incision is made down to the testis and through the tunica albuginea. Pressure on the testicle extrudes a small portion of the tubular structure which is then snipped off with a fine scissors. A single suture usually suffices to close the incision. Such a biopsy will give a true histologic picture of the structure of the testis.

**Ligation of the Vas Deferens.**—Operations on the structures of the spermatic cord include ligation or resection of the vas and operations upon varicoceles. Ligation of the vas was widely used formerly and is still used by many people as a prophylactic measure against epididymitis following prostatic surgery. It is possible to do subcutaneous ligation of the vas without incision of the skin. However, the procedure is somewhat unsatisfactory and is not recommended. It is better to expose the vas through a small incision in the scrotum. The vas can be easily isolated from the other structures of the cord since it has the largest diameter of any of the cord structures and its characteristic hard, firm consistency is easily identified. Through a tiny incision with local anesthesia, it is possible to free the vas, doubly

radiopaque substances to outline the ejaculatory ducts and seminal vesicles. Catheterization of the ejaculatory ducts through the endoscope has entirely supplanted these procedures.

**Varicocele.**—Varicocele, a varicose condition of the veins of the spermatic or pampiniform plexus, is found in a fair percentage of all males. In most of them, it causes no symptoms whatsoever and no serious organic change. In a few the stasis of blood leads to gradual atrophy and softening of the involved testicle. In a larger number it causes symptoms of variable severity.

It occurs nearly always on the right side, but may occur on the left side and the anatomic difficulties are more numerous on the left side.

It might be an etiologic factor. In a very few cases of varicocele the appearance of the condition may have an important diagnostic significance. When a varicocele appears rather suddenly in an older individual, it is important to remember that such a condition is occasionally caused by a tumor in the kidney or retroperitoneal region. This is especially true on the left side where the spermatic vein empties into the renal vein and where growth of tumor tissue in the

vein as well as the general enlargement, may cause rather sudden appearance of a varicocele

The great majority of varicoceles are insidious in their onset and cause no symptoms at all or only indefinite symptoms of dragging or sensation of abnormal weight. The varicocele appears as a swelling

the patient is in the recumbent position. The usual case is relieved by mild support such as is provided by a light suspensory. If the symptoms are of such severity as to cause any disability, or if there is evidence of change in the consistency or size of the testicle, surgery provides the best cure. Injection and sclerosing technics are too uncertain to be used in these cases. The operation is best done through a high scrotal incision extending to just below the inguinal ring. Very careful dissection is used to isolate the varicosed veins from the vas and artery. Carefulness must be emphasized, for if the arterial supply to the testis is in any way damaged, atrophy will follow and the operation will leave the person worse off than he was before. Resection of the entire mass of veins is not necessary but may be done if the dissection can be easily carried out. It is usual to attempt to shorten the cord by suture of the stump of the resected veins to the structures near the inguinal ring. This supports the testicle at a higher point and most surgeons feel this is helpful.

**Testicular Complaints in the Psychoneurotic.**—A word of warning should be interjected at this point about the psychoneurotic with symptoms referred to the testicles. An appreciable number of patients fall into this group. They complain of indefinite or unusual pains and aches referred to the genital region and particularly to the testicle. There may be some minor degree of varicocele or thickening of the cord structures or there may be no abnormal findings. One should be wary about operating on these individuals if they have a mild varicocele. If the symptoms are relieved by adequate support, there is good reason to hope that surgery may be followed by permanent relief of their symptoms. If the symptoms persist despite support, as they usually will in a neurotic individual, one cannot hope surgery

These remarks will, we hope, help the practitioner who does not specialize in urology to handle the minor urologic problems which arise in the practice of medicine.

## MINOR GYNECOLOGIC SURGERY

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### BIOPSY AND CURETTAGE

ALTHOUGH classed under minor surgical procedures, biopsy and curettage are of decidedly major importance. Biopsy or curettage findings dictate the proper management. Failure to observe this important diagnostic step preliminary to the institution of surgical or medical treatment of a given patient has resulted in what amounts to a moral malpractice, to wit, inadequate surgery or failure to intervene while the malignant process advances beyond the stage amenable to adequate surgery or curative radiation therapy. Furthermore, the two procedures are important from the point of view of prognosis. Comparative biopsy or curettage studies at properly spaced intervals will accurately reveal the tissue response to therapy and thus permit a more nearly accurate prognostic evaluation. This has been shown by Schmitz, Sheehan and Towne on corpus cancer and more recently by Spear and Glucksmann on cervical cancer.

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disease was most frequent in the alimentary tract in the male and in the reproductive tract in the female. Of the female reproductive tract, the distribution in the order of decreasing frequency was according to Pearl, uterus (50 per cent), breast (30 per cent) and ovary (20 per cent), and according to the mortality statistics from England and Wales, uterus (46.12 per cent), breast (45.17 per cent), ovary (6.21 per cent) and vagina and vulva (2.40 per cent). The relative incidence of cervical to corpus cancers is generally placed around 10:1. The cervix, therefore, is the most frequent site of malignancy.

Early detection of malignant changes requires judicious utilization of biopsy. It is essential that an adequate amount of tissue be obtained

tation rather than biopsy particularly in a woman past the child bearing period and in whom malignancy is suspected. Findings of early cancer in the cervix removed at plastic operation or in the course of Manchester operation and in the cervix of a hysterectomized specimen emphasize the need for repeated biopsies and eternal vigilance. Cancer of the cervix can and does occur without any sign or symptoms and may not be recognizable except by histologic study. Since even a normal appearing cervix may harbor carcinoma it is

inflammatory and chronic irritative lesions including erosions ectropions lacerations etc. as well as from the more frankly appearing

anaplastic changes ordinarily associated with cancer but without the penetration through the basement membranes. Such a picture of non-invasive cancer however may also be seen if only the very margin of a frankly malignant lesion is studied. Furthermore the follow up studies by TeLande and Galvin on a series of cervixes diagnosed "pre-invasive" carcinoma by biopsy showed that invasive character may be present elsewhere in the lesion. They are of the opinion that abnormal cellular activity which eventually results in fully developed cancer begins in the basal cells of the surface epithelium and that the surface lesions may exist for years before developing gross carcinomatous lesions.

The value of tissue study in prognosticating the clinical course of cervical cancer has been recently emphasized by Spear and Glucksmann. These investigators have found that, with the "Stockholm Technique" and its modifications the most "radio curable" are the *well differentiated* growths and that the differentiated tumors predominate in the early and the undifferentiated in the late stages of the disease. Furthermore by comparative qualitative and quantitative histologic studies of preradiation and postradiation tissue sections Glucksmann has worked out a method whereby it is possible to make a more nearly accurate prognosis of the final results of the treatment. Sections must always be taken from the growing edge of the tumor as the section from the center may show cells too necrotic to give results of any value. Biopsies are taken on at least two occasions after treatment is started.

It is apparent from the preceding remarks that biopsies have both diagnostic and prognostic significance. It is also obvious that what has just been said is applicable to biopsy studies of sites other than

the cervix One additional point requires mentioning Dr James Henry, the pathologist, has frequently observed that, although the biopsied tissue showed no malignancy, the lymphatic and blood vessels may at times show congestion or stasis to suggest nearby obstruction possibly on the basis of adjacent new growth Further biopsies taken at his recommendation have revealed the presence of malignancy at a higher location The role of biopsy in such cases was to direct the investigation toward the possible site of the lesion

Judicious, full utilization of this most important procedure is absolutely essential for the proper management of a patient The more frequently biopsies are taken, the greater will be the data available for true evaluation

### ENDOMETRIAL BIOPSY AND CURETTAGE

Endometrial biopsy and diagnostic curettage must be employed similarly to biopsy procedures elsewhere Endometrial studies are necessary for the intelligent management of problems in sterility and menstrual dysfunction particularly where hormonal therapy is used Endometrial biopsy has the practical advantage of office applicability With proper precaution, it has been used to diagnose or rule out

a biopsy of the uterine  
the nature of the uterine

lining includes data regarding the contour of the uterine cavity diagnostic of the presence or absence of such tumors as myoma Therapeutically, curettage may control bleeding in incomplete abortion, in complete shedding of the endometrium and some bleeding due to unknown factors Here again, a procedure may serve a dual purpose of diagnosis and therapy

### CERVICAL DILATATION

Dilatation of the cervix is an essential preliminary to the curettage but, in the treatment of cervical stenosis or stricture, this procedure is the important part Dilatation must be gradual to guard against trauma leading to secondary stenosis or stricture from scar tissues In the treatment of dysmenorrhoea secondary to the cervical stricture stem pessary may be inserted after the dilatation to maintain an adequately patent cervical canal

Secondary cervical stenosis or stricture may result in hematometra and pyometra Particularly in the latter drainage is important A simple rubber T drain made from firm tubing may be inserted after the dilatation The preparation of the T drain from a rubber tube is illustrated in Figure 70a

The importance of proper treatment of cervical stricture or stenosis becomes apparent when the high incidence of pelvic endometriosis is considered in the light of the generally accepted Sampson's theory of

retrograde drainage. It becomes still more important when authorities such as Curtis consider obstructed uterine drainage an important factor in the development of carcinoma in the body and cervix of the uterus. Furthermore, retrograde drainage of pus from a pyometra will cause peritonitis and may even result in the death of the patient.

#### CAUTERIZATION, CONIZATION AND AMPUTATION OF THE CERVIX

As has been mentioned previously, the detection of early malignancies with increasing frequency even in normal appearing cervixes makes it imperative that all diseased cervixes be treated and if they

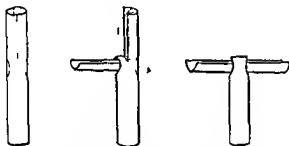


Fig 70a—Preparation of rubber T drain

stenosis is still the procedure followed today. Excellent results have been obtained but postcauterization checks must be made to insure adequate patency of the cervical canal.

Conization and amputation have been employed in cases of cervicitis resisting ordinary cauterization. Both procedures have given excellent results but both are not without some disadvantages. Miller and Todd in a series of 899 conizations reported strictures of the cervix requiring dilatation in 6.46 per cent and an increased tendency toward premature labors in those who became pregnant.

Cervical amputation is not advocated in women in the child bearing period as the incidence of abortion, premature labor and difficult labor was shown to be greatly increased following the amputation. Another disadvantage is the relative frequency of postoperative bleeding occurring in about seven to fourteen days. In properly selected cases, however, cervical amputations as a part of plastic operation or Manchester operation have given excellent results.

#### COLPOCENTESIS, COLPOTOMY AND COLPOPERITONEOSCOPY

Colpocentesis, colpotomy and colpoperitoneoscopy are diagnostic procedures which will eliminate most unnecessary "exploratory" laparotomies and at the same time will not subject the patient to the



risk of "expectant treatment" resulting from uncertainty of diagnosis. Colpocentesis is of particular value where intra abdominal bleeding of gynecologic origin is under consideration. Withdrawal of old blood

ing produced by neoplasm should not be difficult when the history and clinical findings are correlated with the colpocentesis finding. Aspiration of bright red or fresh blood does not indicate intra abdominal bleeding but rather a puncture of blood vessels. Failure to withdraw any blood of course does not rule out ectopic pregnancy. In all questionable circumstances, colpotomy exploration will reveal the true pathologic condition.

Through a colpotomy wound the pelvic organs may be directly observed as well as palpated. Even major surgical procedures as salpingectomy and oophorectomy have been performed. If findings re

By this method a positive diagnosis of pelvic endometriosis is possible without the "exploratory" or "diagnostic" laparotomy.

Colpoperitoneoscopy studies are now being reported by TeLinde. Accurate study of the pelvis and its content is now possible. As the operators familiarity with the intrapelvic appearance of the organs increases earlier recognition of pathologic deviation will be possible. The tremendous import of this fact becomes apparent when we consider that the present poor salvage from ovarian malignancy is too

greater curability

The value of colpoperitoneoscopy is not confined to diagnosis by observation. Biopsy and even some treatment should be possible. Therapeutic colpoperitoneoscopic instruments on the order of the

common practices. Any removal of organs or parts of organs such as tubes or ovaries belongs under major surgery and will not be discussed here, even though the procedure is carried out through the colpotomy incision.

#### RADIUM INSERTION AND PLASTIC OPERATIONS

Radium insertions and plastic operations such as the repairs of urethrocele, cystocele, enterocele, rectocele and third degree lacera

tion are classed under minor surgery by many operators but are, in reality, major procedures. Proper use of radium requires intimate knowledge of radiology if effective end results are to be obtained without the unfortunate sequelae so often caused by mismanagement. Adequate knowledge of the physical properties of radium and the physiological responses evoked by it will limit its use to certain conditions and will avoid inadequate radiation or radiation burns. Radium in the hands of a competent operator is a valuable and effective therapeutic agent, but in the hands of a person not qualified, it becomes a dangerous and harmful instrument.

Plastic operations belong among the major surgical procedures. Proper corrective operations imply detailed knowledge of anatomy. Studies by Curtis, Anson and others have revealed the anatomical complexity of the female perineum and pelvis. Failure to recognize the finer but more important anatomical points may result in annoying complications or rapid recurrence of the original condition.

### OTHER MINOR SURGERY

**Bartholin's Gland.**—Acute bartholinitis usually responds to adequate chemotherapy and operative procedures should be avoided. Where incision and drainage becomes necessary, the patient should be warned of the likelihood of recurrence and eventual need for excision.

Chronic bartholinitis and Bartholin cyst may require removal. Complete surgical excision or destruction of the entire lining by heat or chemicals is necessary for cure. The usual surgical method is to dissect out the entire sac intact but Curtis advocates incision through the gland substance, grasping the posterior wall of the sac and peeling the entire sac by traction and dissection. Schaeffer prefers to treat the abscess or cyst by cruciate incisions over the skin and tumor and destruction of the entire sac and gland.

removal of chronically infected Gland's gland . . . . .  
cent anatomy  
the perineal  
cedure would seem palliative rather than curative

**Hymenectomy.**—Enlargement of the hymenal orifice may be accomplished by multiple incisions of the hymenal membrane or may require a little more extensive corrective procedure. Incision of the perineum in the midline and closure of the incision in the opposite direction will provide a permanent enlargement of the introitus. In some cases of vaginal stenosis, the underlying muscle in the perineum may have to be incised and sutured in the opposite direction to enlarge the vaginal outlet.

## HAZARDS OF ANESTHESIA FOR MINOR SURGERY

W H CASSELS, M D \* AND L L TEPLINSKY, M D †

ANESTHESIA for minor surgery may be more hazardous than anesthesia for major surgery. Brief anesthesia does not mean minor anesthesia, a patient can be just as dead after five minutes as after five hours. The greatest hazard stems from the mental attitude of the surgeon. Because the operation is expected to be minimal, he views the anesthesia in the same light. All too often the anesthetist is asked to give a "whiff of gas" or "a little pentothal" for a short procedure,

major operations. In fact, minor surgery often presents problems that are automatically eliminated in the well prepared case requiring a major operation, since many of the minor procedures are performed on patients who come in as emergencies or as outpatients. They are frequently dealt with in the dispensary or the surgeon's office where facilities for prompt treatment of complications may be entirely inadequate.

Preparation is an important factor in the insurance of good safe anesthesia. Often there is no discussion between surgeon and anesthetist about the case at hand. The surgeon should give a brief estimate of the situation and an idea of what his tentative plans are whereby the anesthetist is better able to determine the anesthetic agent of choice and the method best suited for the occasion. This presupposes that a competent anesthetist is available. Many of the accidents of anesthesia are the direct result of incompetence in administration, since it is often felt that because this is a short minor operation, anyone who may be on hand at the time is sufficiently qualified to give the anesthetic in spite of the fact that he may have had little or no training and experience in this type of work.

The set up for anesthesia in minor surgery should be just as elaborate as for major surgery. This means that enough supplies and equipment should be on hand and readily available to the anesthetist in the event of any complication or change in plans. Often a minor operation may prove, on detailed examination, to be a prolonged major procedure necessitating a re-evaluation of the entire situation by the anesthetist. Can the anesthetic agent and method now employed

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be continued or would it be best, in the interest of safety to the patient, to change to some other agent? With an adequate set-up, changes can be made quite readily if deemed necessary, with minimal confusion or delay.

CASE I—An elderly man was admitted to the University of Illinois Research and Educational Hospitals and was scheduled for insertion of radon seeds to the base of the tongue under pentothal anesthesia. The anesthesia proceeded uneventfully for ten minutes while the radon seeds were successfully inserted. At the end of this time it was found that there had been considerable hemorrhage into the tissues of the tongue so that the base of the tongue was becoming markedly swollen and respiratory obstruction was inevitable. Fortunately assistance and all necessary facilities were at hand. With difficulty an endotracheal tube was inserted and

office, the results might have been fatal

*Preparation of the patient* is another very important consideration. Since many of the minor surgical procedures are performed on out patients, this presents more of a problem than in those patients who are hospitalized. Vomiting during or immediately following a general anesthetic is a very common cause of respiratory complications and is responsible for many fatal accidents. Patients who have eaten within four to six hours should be rendered in the "left lateral" position and adequate facilities for suction should be available. The patient should be positioned on the left side, which usually results in the vomitus being aspirated into the trachea, which can be easily tilted to the right and not be done on the ordinary cart or stretcher. This position allows the vomitus to gravitate out of the mouth rather than be aspirated into the tracheobronchial tree. Adequate suction should be within immediate reach. Careful instructions must be given the patient regarding food intake prior to anesthesia. If the procedure is to be done in the morning, the patient should be instructed to eat a light breakfast. It is sometimes advisable to perform a gastric lavage to rid the stomach of most of its contents.

Preanesthetic medication should be given those patients who are to receive an anesthetic. When a local anesthetic agent is to be used, some form of barbiturate is given as a prophylactic against one type

If a more drastic action is deemed necessary, some drying agent such as atropine or scopolamine should be given for its depressant effect on mucus secretions. Morphine in small doses may be given along with the drying agent, especially in those instances where the patient

is apprehensive and demonstrates a high reflex irritability. These drugs can be given subcutaneously one and one half hours before the start of anesthesia. If the intravenous route is used, the effect is almost immediate. In general, adequate preanesthetic medication is aimed primarily at increasing the safety of the patient. Reduction of mucus secretion *minimizes some of the respiratory hazards of general anesthesia*, and proper psychic sedation allows for smoother induction and maintenance of anesthesia and reduces the concentration of agent required.

Anesthesia for outpatients presents another problem often overlooked which must be considered in the discussion of possible hazards. Patients coming to the office or dispensary should be accompanied by a responsible individual who will see to it that the patient travels with maximum safety. Sedative drugs used as premedication and anesthesia in general often produce changes in sensorium not readily recognized. Although the patient may appear quite alert following an anesthetic his judgment may be sufficiently impaired that, if allowed to go home by himself he may become confused and wander away or be involved in an accident.

In the following pages some of the important complications which may occur are discussed

## RESPIRATORY HAZARDS

**Lack of Oxygen in Inhaled Atmosphere**—Because of the minor nature of the operation and the expected brevity of the anesthesia, nitrous oxide is very commonly administered for minor surgical procedures. While nitrous oxide is a very valuable agent, it must be used judiciously and one must remember that it is so lacking in potency that to produce even light surgical anesthesia may require such a high concentration of the gas that the oxygen content of the mixture is reduced to a dangerous level. This is particularly true when patients have not been rather heavily premedicated with morphine. After the respired atmosphere is depleted of oxygen, serious anoxemia may result in death.

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recognized first by the lack of respiratory exchange and second by the absence of all movement indicative of respiratory effort. While there are numerous causes both central and peripheral which may lead to respiratory arrest those which are commonly associated with general anesthesia are (1) overdosage of the anesthetic agent producing

where which is in the patient's lungs at the time when the respiratory arrest occurs. If a mixture with low oxygen such as is common in nitrous oxide anesthesia has been administered the reserve of oxygen in the lungs will be minimal and severe anoxemia will develop rapidly. If on the contrary an atmosphere rich in oxygen has been administered there will be sufficient in the lungs to maintain oxygenation for several minutes.

When respiratory arrest is recognized treatment should be instituted immediately. The urgent requirement is to force an atmosphere containing adequate oxygen into the patient's lungs by some method of artificial respiration. One of the best methods in such an emergency is mouth to mouth or mouth to nose breathing. The operator places a piece of gauze or a clean handkerchief over the patient's mouth, closes the nose by squeezing it and blows his own exhaled breath into the patient's respiratory tract. He then withdraws and allows the lungs to deflate. This procedure is repeated about twenty times per minute. If the nasal route is utilized the operator closes the patient's mouth with his hand and blows in through the nose. As in all forms of artificial respiration it is essential that the air passages be patent and that the atmosphere be successfully delivered into the lungs. Mouth to mouth or mouth to nose respiration has several advantages. It is always an available method. It does not involve apparatus which in the haste of the moment may be misused or which may be out of order. It provides for free elimination of an inhalation agent.

The common manual methods of artificial respiration are less effective and frequently are not performed in an efficient manner. If a manual method is preferred intermittent pressure on the chest will frequently cause sufficient exchange to eliminate a moderate overdose of an inhalation agent and to maintain fairly good oxygenation. If necessary the Sylvester maneuver involving pressure on the chest followed by elevation of the arms to cause inspiration may be resorted to.

Almost any anesthesia machine can be used for efficient artificial respiration but one must be sure that the emergency has not been precipitated by some mechanical defect or erroneous adjustment of such machine. Patients have been killed because of inadvertent administration of nitrous oxide when the anesthetist thought that oxygen was being delivered. Resuscitators are on the market which can be

used for efficient artificial respiration, but they are not likely to be on hand at the critical moment or may be out of order, and therefore it is safer not to depend on them.

Once efficient artificial respiration is instituted, the urgency of the situation is relieved. In most cases the cause of the respiratory arrest will be removed by the artificial respiratory exchange. If the cause persists, time may be taken to evaluate the condition and other appropriate means taken to treat it. One must remember that there is a tendency to overdo artificial respiration, thus reducing the carbon dioxide content in the patient's blood below the normal level. This may result in *apnoea*, which will prevent spontaneous respiration and may mislead the inexperienced person into assuming that the original cause of the respiratory arrest is still present.

Analeptics are of little or no value in these cases and may even be dangerous. Likewise, the administration of carbon dioxide is contra-indicated. The patient in respiratory arrest is likely to have an abnormally high carbon dioxide content in his blood already, and the addition of carbon dioxide to the inhaled atmosphere may bring the blood content to a toxic level. The paralyzed respiratory center will not respond to increased carbon dioxide.

2. *Respiratory Obstruction*—This type of cessation of respiratory exchange is recognized first by the lack of movement of air through the mouth or nose and second by persistent efforts to breathe. These respiratory movements create a typical picture which the experienced anesthetist readily recognizes. Because air cannot pass into the lungs the actual capacity of the chest cannot be increased. Some muscles of respiration have a mechanical advantage over others so that some parts of the chest expand while others retract. The diaphragmatic component tends to predominate, causing protrusion of the abdomen. There is also elevation in the pectoral region but there is depression of the sternum, the lower costal region and very often depression of the suprasternal notch. During the expiratory phase the abdominal muscles become tense and the retracted areas of the chest expand.

There are numerous causes of respiratory obstruction during anesthesia. The most common is related to the relaxation of the muscles of the tongue and jaw with a consequent falling back of the tongue against the posterior wall of the pharynx. This condition may be relieved by extending the head while it is on a pillow and pulling the mandible forward. If this fails a pharyngeal airway may be inserted. If the mouth cannot be opened for the insertion of an oral airway a rubber tube may be passed through the nose into the pharynx to lie just above the larynx.

Another very disturbing cause of obstruction is *laryngospasm*. This may be due to local irritation of the larynx by an irritant anesthetic, such as ether, or by some foreign substance, such as mucus on the cords. Laryngospasm may also be caused reflexly by certain surgical

manipulations such as traction on the cervix. Sometimes laryngospasm will be spontaneously relieved when there is increased stimulus to breathe due to increased carbon dioxide and reduced oxygen in the blood. However, the spasm may persist to a dangerous point. If simple means such as aspiration of mucus from the pharynx or removal of the irritant ether, fail to relieve a spasm, it may be necessary to insert an endotracheal tube which will provide a patent airway past the larynx. Laryngospasm is particularly apt to occur during the pentothal anesthesia and has undoubtedly been responsible for many of the deaths attributed to this agent.

CASE II—A robust young man was scheduled for a very minor operation with

An attempt

to prevent a life

Pentothal anesthesia is far too commonly regarded as the method of choice for minor surgery. Not only is laryngospasm apt to occur but other reflexes persist after the patient appears satisfactorily anesthetized. Incision of the skin may result in violent reactions by the patient. In an effort to control the reaction to stimulation more pentothal may be added with the result that too deep anesthesia is produced. The above case illustrates the fact that it would be more judicious to treat the anesthesia even for simple operation as a major procedure and proceed with the most judicious method. This patient should have been anesthetized with an inhalation agent and intubated before the surgeon was allowed to proceed.

Another cause of obstruction is the presence of a foreign body in the pharynx, larynx or trachea. Patients for minor surgery are particularly likely to have this type of obstruction because they are inadequately prepared. A patient who has had a meal shortly before anesthesia is very apt to vomit undigested food which may lodge in the larynx or tracheobronchial tree. Similarly due to the nonchalant attitude of those concerned there is apt to be no effort to insure that the patient does not have some foreign body such as chewing gum, tobacco or false teeth in his mouth at the time the anesthesia is started. Some minor operations about the mouth such as tonsillectomy may result in a piece of tissue or a sponge being accidentally



allowed to lodge in the pharynx or larynx. The treatment of obstruction due to foreign bodies is primarily one of prophylaxis. The properly prepared patient will be less subject to such accidents and the anesthetist who approaches the procedure with due caution will provide adequate facilities for dealing with such conditions if they arise. This should include having the patient on an operating table which will tilt in order to facilitate gravity drainage, having a suction machine available and having a laryngoscope and endotracheal equipment on hand. Prompt and efficient use of such facilities should nearly always prove successful.

Sometimes obstruction may result from anatomical peculiarities of the patient. The short thick-necked individual is very likely to develop obstruction which may be difficult to relieve. Similarly, a patient may have an enlarged thyroid gland or other tumor in the neck which may result in obstruction as the anesthesia develops. An abscess of the neck may result in laryngeal edema which may cause complete obstruction even without anesthesia or may result in obstruction becoming acute after anesthesia has been induced. Most of these obstructions can be relieved by the insertion of an endotracheal tube if the

with no respiratory effort. However, when artificial respiration is instituted, it will be found that air cannot be forced into the lungs. Therefore an obstruction must be suspected and dealt with. Once the obstruction is relieved, artificial respiration must be continued until spontaneous respirations are resumed. The most common causes of this condition are (1) deep anesthesia causing respiratory arrest and at the same time causing relaxation of the tongue and jaw with pharyngeal obstruction, (2) respiratory obstruction leading to an acute lack of oxygen and subsequent paralysis of the respiratory center.

**Postanesthetic Respiratory Complications**—Some of the sources of foreign substances in the respiratory tract have already been listed.

suspected in the  
bronchial tree, a tracheobronchial toilet may be performed by the anesthetist or bronchoscopy may be indicated.

## CIRCULATORY HAZARDS

**Cardiac Arrest.**—Sudden acute cessation of cardiac activity can occur during short anesthetics for minor procedures almost as readily as during major operations. Several causes may be considered (1)

tion of the carotid sinus (2) Overdosage of anesthetic agents. Some anesthetics, such as ether, cause vasomotor dilatation which may result in a fall in blood pressure and cardiac failure. Others, such as ethyl chloride, chloroform and cyclopropane have direct effects on the heart. cyclopropane slows the conduction time, chloroform and ethyl chloride may directly depress the myocardium (3) Ventricular fibrillation. Particularly with chloroform or ethyl chloride, stimulation during light anesthesia may cause a discharge of epinephrine resulting in ventricular fibrillation. Since many minor surgical procedures are carried out under light anesthesia, frequently the quicker acting agents, such as chloroform and ethyl chloride, are used. This is a serious hazard (4) Acute oxygen want, such as may be caused by lack of oxygen in the respired atmosphere or by one of the respiratory emergencies outlined above may lead to cardiac arrest which may respond to treatment.

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con

pulsation can be detected at any artery nor over the precordium (2) Respiratory arrest. Owing to the rapid onset of cerebral anoxia, the respiratory center becomes paralyzed after only a few gasping breaths. In any case of respiratory arrest, the anesthetist should immediately check the pulse to see if the circulation is being maintained satisfactorily (3) Pallor or cyanosis. With cessation of circulation the blood stagnates in the vessels and its oxygen supply is rapidly depleted. If the volume of blood in the vessels of the face is large, there will be cyanosis. This is particularly likely if the patient is in the Trendelenburg position. However, if the patient's head is elevated, there is more likely to be a grayish pallor (4) Cardiac sounds cannot be heard (5) Bleeding in the wound ceases.

The treatment of cardiac arrest must be instituted immediately if there is to be any hope of revival. In the well equipped and well staffed operating room, prompt and efficient treatment will bring about recovery in some cases. In a dispensary or office practice there will be less likelihood that adequate facilities will be at hand. The most important points in treatment are as follows:

1. Time is of the utmost importance and one should immediately note the exact time of occurrence of the emergency and be guided in future actions by the amount of time that has elapsed. One should immediately lower the patient's head so that he is in mild Trendelen

burg position. At the same time, artificial respiration should be instituted and maintained throughout. During the remainder of the first

possible to put a hand on the epigastrium and press the abdominal wall inwards and upwards so that the heart may be squeezed.

If facilities for abdominal incision are available, the second minute should be devoted to preparations for this procedure. At the end of the second minute, if there is no evidence of cardiac activity, an

procedure has been invoked.

If after some minutes of manual artificial circulation there is no evidence of cardiac activity, *intracardiac injection of an analeptic* may be resorted to. Similarly, in cases where manual artificial circulation is

mended. The injection should be made into the right auricle by inserting a needle in the third right interspace close to the sternum and

If cardiac arrest is allowed to persist for more than four or five minutes before circulation is re-established either spontaneously or by artificial means, the probability of irreversible damage to the brain is so great that further efforts may be regarded as useless.

seen most frequently during rapid induction and are due to depression by vasomotor depression and myocardial depression. They are most common when rapidly acting agents, such as chloroform, ethyl chloride, or vinylene are used, partly because induction with these agents is so easy to produce. Patients for minor surgery,

when available) instituted immediately. Administration of the anesthetic agent must be discontinued at once. As a rule these cases respond quickly to this treatment. If the condition persists for more than a minute, one should consider the diagnosis of cardiac arrest and prepare for appropriate treatment. These episodes must be regarded as serious. Some of them are likely to lead to death.

Once recovery has taken place, a re-evaluation of the patient's con

be expected to depress the myocardium, it is legitimate to assume that this was a transient episode unassociated with irreversible changes. In such cases it is reasonable to proceed with a minor operation. However, if the patient is old or is known to have circulatory disease or if the anesthetic agent was one which should not depress the myocardium and was not given in overdosage, the condition should be regarded as an ominous warning and it would seem better to postpone the operation if possible and consider the advisability of using some other method such as local anesthesia if the operation eventually must be performed.

CASE III - A four months old baby was scheduled for second stage repair of cleft lip. She was premedicated with 1/1000 Induction was started this was continued for about 10 minutes. Tremendously cyanotic respirations were noted. Mouth to-mouth artificial respiration was continued for about two minutes before the heart beat returned and the color improved and respirations returned spontaneously.

This circulatory collapse was undoubtedly due to the effects of ethyl chloride. A fatal outcome might very easily have resulted. Such incidents are just as likely in a minor as in a major operation.

## HAZARDS OF LOCAL ANESTHETICS

Local anesthetics are widely used for minor surgical procedures. They are often mistakenly regarded as involving no risk. Actually, toxic reactions to local anesthetic agents are not uncommon and may prove fatal. These reactions may take one of two forms: (1) circulatory depression, (2) central nervous stimulation. In some cases both types may occur simultaneously.

Circulatory depression due to local anesthetics is characterized by faintness, dizziness, weakness, pallor, marked bradycardia, frequently slow and irregular pulse, and may be followed by death.

Central nervous stimulation due to local anesthetics is characterized

by restlessness, talkativeness, delirium, twitchings, convulsions and perhaps death

Among the etiological factors to be kept in mind are the following

1 Sensitivity Although any individual may manifest toxic reactions if subjected to a sufficient overdose of a local anesthetic drug some individuals have a very low tolerance and may develop serious reactions with minimal doses

2 Overdosage Certain doses of local anesthetics are regarded as relatively safe in the average individual. If one exceeds these doses there is increased danger of toxic reactions

3 Concentration The toxicity of local anesthetic solutions increases greatly with increased concentrations. For instance, 1 cc of 2 per cent procaine is said to be four times as toxic as 1 cc of 1 per cent procaine. It is said that the average safe dose of 1 per cent procaine is about 125 cc. The safe dose of 2 per cent procaine is only 30 to 40 cc. One exception to the rule regarding increasing toxicity with increasing concentration may pertain to cocaine solutions used for topical application. Because cocaine is itself a vasoconstrictor, it is felt by some that high concentrations cause greater vasoconstriction and therefore less rapid absorption. Thus cocaine solutions used for anesthetization of the pharynx, larynx and trachea range from 4 per cent to 20 per cent. If one uses a high concentration naturally he should avoid a large volume.

4 Rate of absorption Local anesthetic solutions injected into vascular areas are more likely to be rapidly absorbed and therefore are more likely to produce toxic effects. Intravascular injections of even small amounts may produce serious results.

Certain precautions should be taken to avoid local anesthetic reactions

1. History should be made as to whether the patient has ever had

4 Unless otherwise contraindicated, a vasoconstrictor, such as

(draw back on plunger) before making the injection. An exception to this rule may be made when the needle is in constant forward or backward motion during the injection.

7 Since it has been shown that a barbiturate given in sufficient dosage to cause noticeable depression will minimize the likelihood of central nervous stimulation, it is desirable when possible to give

the patient such a drug e.g. pentobarbital an hour or more before administering the local anesthetic. One must remember however that a barbiturate is no absolute guarantee against convulsive reactions and it has absolutely no prophylactic value as regards circulatory collapse.

8 If a patient has developed a toxic reaction from which he has recovered it is the duty of the surgeon or anesthetist to warn that patient that he may be sensitive to these drugs and that no surgeon or dentist should administer a local anesthetic again without due caution.

The treatment of circulatory collapse due to local anesthetic agents consists of (1) the administration of a vasopressor drug such as epinephrine, ephedrine or neosynephrine. If the reaction is mild the drug may be administered intramuscularly. In severe cases however it may be advisable to administer it intravenously in which case ephedrine is probably the drug of choice. The injection should be made slowly and only up to the point of beginning circulatory improvement. The dose required for this may be from 12 to 25 mg. (2) Lower the patient's head. (3) Administer oxygen if it is available. (4) Administer artificial respiration if the patient's respirations fail.

The treatment of central nervous stimulation due to local anesthetics consists of (1) the intravenous administration of a rapidly acting barbiturate. For this purpose pentothal sodium is satisfactory. It should be given in sufficient dosage to control the convulsion. As a rule only a small amount is required and overdosage is unlikely. If a large dose is required it may be necessary to perform artificial respiration to overcome respiratory depression. (2) Administer oxygen if it is available. (3) Administer artificial respiration if respirations fail.

CASE IV—An outpatient was brought to the operating room for cystoscopy. The recorded physical examination was limited to the genitourinary system. No pre-

This case occurred quite a number of years ago. Today one would hesitate to use 2 per cent procaine in the caudal canal especially when the patient had already had a topical anesthetic injected into the urethra. Had the operation not been regarded as a minor pro-

### SUMMARY

Anesthesia for minor surgery may be more hazardous than anesthesia for major surgery, because there is likely to be less adequate preparation of emergency facilities and of the patient. More hazardous methods of anesthesia are sometimes used. The anesthetic is often administered by an unskilled person. The patient may be allowed to go home unescorted while his mental abilities are still impaired. The recognition and treatment of some emergencies, viz., respiratory complications, cardiac arrest, circulatory collapse and toxic reactions to local anesthetic agents, are discussed.

## PLASTER OF PARIS TECHNIC FOR THE APPLICATION OF CASTS

CLAUDE N LAMBERT, M D \*

THE problem of immobilization in cases of fractures or other orthopedic conditions has always been an important one, and many means to obtain such immobilization have been employed in the past. The ancients used splints made from tree branches, held in place with a combination of straw and mud the latter drying to form an encasement. This encasement has been gradually improved until at the present time most of the encasements are made from plaster of Paris and the encasements are referred to, almost universally, as casts.

Plaster of Paris is basically calcium sulfate, or gypsum, which has been heat treated, so that most of its water of crystallization has been driven off. When water is added to the anhydrous calcium sulfate it resorbs water and then crystallizes out in fine needles which, when rubbed well together form a uniform mass. During this process and the subsequent "setting" or hardening of the process the definite chemical reaction of absorbing water produces heat and it is this reaction about which the patients will comment namely that the cast gets quite warm during its application. This warm period passes rather quickly and then the patients will comment about the cold wet feeling of the cast.

Theoretically the plaster of Paris could be used directly, by mixing some of the fine white powder with sufficient water to make a paste and then spreading the paste over the arm or leg of the patient with a trowel or a similar instrument to make a cast. In fact, it is surprising how many people think that present day casts are constructed in this manner. Many times while applying a cast I have had parents or friends of the patient in the plaster room who were quite astonished or amazed that a cast is a logical way just as if we over which braces are fitted but actual casts made in this manner would not be satisfactory inasmuch as they would lack strength and stability.

and grade of crinoline that has been sized with starch. It is this starch sizing in the crinoline that gives a blue coloration when a plaster of Paris bandage comes

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in contact with the skin which has been painted with iodine—the chemical test for iodine

### ADVANTAGES AND DISADVANTAGES OF THE PLASTER CAST

bandages Third, it is easily transported and can be stored almost indefinitely \* Fourth the plaster bandage is easy to apply and needs no special apparatus or solvents except water Fifth it can be made to last as long as necessary by proper reinforcements and protection, and sixth, it is easy to remove Seventh, it can be modified, wedged and the like with minimum effort, and extra apparatus such as turn buckles can be included either at the time of application or added later with minimum effort

have seen plaster casts at least  $\frac{1}{2}$  inch thick and in places 1 inch thick Of course this thickness will add weight to a cast but it is not necessary to obtain immobilization

The advocates of the synthetic plastic type casts or those made from glass fibers and the like insist that their material is less impervious to x rays with the exposure through the cast On this I will agree but in the ordinary case we are not looking for bone detail particularly in the case of fractures, until six to eight weeks have elapsed after the time of the fracture We are mainly interested in the position of the fragments in certainly be

difficult than the reason Another often irritating to the underlying skin or the patient has a genuine sensitivity to the solvent One of our nurses had a synthetic cast applied to her leg,

\* I formerly believed the latter until I went into service in the past war The

and within four hours the leg was so swollen from the chemical irritation of the solvent that the cast had to be removed and she had a contact dermatitis that persisted for several weeks. A further disadvantage is the much longer setting time of the synthetics—so long in fact that I have been unable to hold one in position until it has really set. I will agree that for casts made over molds the synthetic ones are excellent they are light and they are impervious to water.

Taking all factors into consideration I am convinced that the plaster of Paris cast has much more to offer than any substitute developed to the present time.

### TYPES OF PLASTER BANDAGES

There are two main types of plaster of Paris bandages the fast setting and the "slow setting." By setting time is meant the time elapsed from the moment the bandage is immersed in water until the plaster has set or hardened sufficiently that it will maintain its new molded shape. This is not the finished hardness which will not be reached for four or five days after application when the excess moisture in the cast has evaporated. The "fast setting" plaster has a setting time of approximately four to five minutes while the "slow setting" plaster has a setting time of about ten to twelve minutes. These periods cannot be stated more accurately because there are many factors that will influence the setting time. A warm moist humid day will increase or prolong the setting time while a dry day will shorten it. The temperature of the water into which the plaster is immersed will affect the setting time. If the water is warm to hot the plaster will "set" faster and if the water is cold it will take a longer time. Some have advocated the addition of salt ordinary table salt or sodium chloride to the water to speed up the setting of the plaster. The salt will do this but in the process such a brittle cast results that it is not advocated. Others have advocated the addition of sugar to the water to slow down the setting time—this seems a very unnecessary waste of sugar. A thin cast will take longer to set than a thick one the bulk of plaster in the lat

Formerly most of the plaster was "homemade" and in so of a medium fine mesh is used the dry plaster of Paris powder is gently rubbed to give a smooth even filling of the meshes. The advantages of the homemade bandages are that they can be made any width or length to suit particular needs and formerly they were economically cheaper. They were made by nurses or plaster room assistants or even by patients as a form of occupational therapy and there was very little uniformity in either the amount of plaster in the bandages or the tightness of rolling the bandages. Thus there was always considerable waste. Today it is

usually necessary to hire the work done and with present wages the saving in cost is little or nothing. Also the homemade bandages do not store as well, are not wrapped as well, the plaster is easily knocked out of the meshes and the final result is a poorer bandage.

Modern commercial houses have reduced the price of their bandages sufficiently to offset any hoped for savings in the homemade bandages and in addition make a far superior bandage, with the plaster uniformly distributed throughout the crinoline and the rolling consistent. In addition the latest type of bandage has the plaster "baked" on to the crinoline so that it is not easily dislodged. Each bandage is individually wrapped and thus is not greatly affected by atmospheric variations.

The plaster bandages are manufactured in 2 to 6 inch and even up to 8 inch widths and should be available in all sizes. The largest width compatible with the part being casted should be used. For

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width for the particular cast but my advice is to use the largest one practicable.

### APPLICATION OF CASTS

**Materials**—In preparing to apply a cast all of the necessary materials and tools should be placed in a convenient location. The tools used are shown in Figure 71, A. These are two buckets of water, a pair of bandage scissors used in cutting the stockinette felt shears

and the shoes should either be special ones reserved for plaster room work or if regular shoes then they should be covered with heavy

and the shoes should either be special ones reserved for plaster room work or if regular shoes then they should be covered with heavy

hands well afterwards but a little soap and water and being never hurt anyone.

A shadow box should be present in the plaster room so that the x ray films of the case are in view of the surgeon applying the cast (Fig. 72). This aids in the proper alignment of fractures, positioning of joints and so on.

**Padding**—First, the skin should be covered with some protecting

used for holding and displaying the various sizes of stockinette. From this the proper size can easily be selected. The length of stockinette is also important. Never should the stockinette be pulled tight, length

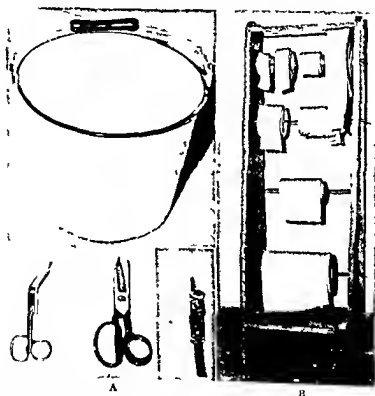


Fig 71—A Tools used in the application of a plaster cast. Large bucket, well filled with warm water, bandage scissors, felt shears and plaster knife. B, Rack for stockinette. Note the various sizes, and ease of selection of proper size.

wise, around a bony prominence, such as the elbow or heel. Many times pressure points are directly attributed to the stockinette which has been stretched to cover an area when really a longer piece should have been selected. The stockinette is placed over the entire part to be casted. It can be tailored to fit around joints by leaving it just snug on the convex surface and cutting it transversely on the concave surface thus having it fit without wrinkles. Figure 73, A, shows an

arm with the stockinette in place and the transverse cut across the cubital fossa to tailor the stockinette properly. Figure 73 B shows the tailoring of the stockinette around the ankle.

It is my belief that all casts should have an underlayer of stockinette. There is considerable disagreement as to whether or not the cast should be "padded." Some advocate no padding at all and the nonpadded cast has become quite popular. There are a few men who can apply a "perfect" nonpadded cast—one that is evenly applied and



Fig. 72—X ray viewing box, which should be present in the plaster room.

well molded and with no pressure points—but the number is small. Having seen the results from many attempts at nonpadded casts which were not perfect, with resultant pressure "sores" I have personally shied away from them. Too much padding is equally bad because with too much padding the cast does not fit and if the purpose of the cast is immobilization this is lost with a loose cast. Indeed, pressure points can be present in a loose fitting cast brought about by rubbing a bony prominence within it. I watched one orthopedic surgeon apply a hip spica cast—he first put on the stockinette then several

layers of sheet wadding, then covered all with large pieces of thick

step technic for the application of such a cast. Although there will



Fig 73—A, Beginning or first step in cast application Stockinette on arm and proper tailoring of the material to fit by means of transverse cut on concave side B, Beginning a leg cast showing tailoring of stockinette around the ankle

be variations to fit the particular case, the principle remains the same in all

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ces and at the  
Two kinds of

felt are available. One is a firm, white felt which may be used where pressure is needed or is anticipated such as the plantar surface of the foot or over the sacrum. The other is a black wool felt, which is softer

are in place (Fig

a layer or two of

crepe paper can be

applied quite snugly, which tightens up or snugs up the underlying sheet wadding and felt and makes a smoother surface over which to apply the plaster. At the time of removal its second advantage is brought out in that it acts as a protecting layer against which the cast may be cut. A charcoal plaster bandage may be used where a

plaster

bucket

sed in

one bucket, the water therein becomes so saturated with plaster that additional bandages will not properly soak out. The second bucket is available for use without the necessity of emptying and filling a bucket in the midst of the procedure.

Figure 74 shows the proper manner of immersing and wringing a commercial plaster bandage. The bandages, one at a time, are immersed horizontally in the water until all bubbling has ceased. This is from ten to fifteen seconds depending on the type of plaster and the tightness with which it was rolled. To properly wring out the bandage it is barely brought out of the water and then gently squeezed on the ends, without any twisting or wringing motion. This removes sufficient water from the bandage but does not push out the plaster. The bandage is now ready to apply.

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concave surface, a dart or tuck is taken on the concave side and smoothed down. The plaster bandage is worked upwards and down

the rubbing is done around the part cast  
The importance of almost constant rubbing during the application of the cast cannot be too strongly stressed. In continued rubbing lies the success of a good cast. Once while I was rubbing a cast quite vigorously the patient objected, stating that when she had a cast

applied previously her doctor had not rubbed it his reason being that he had to allow air holes so that the skin could breathe. Of

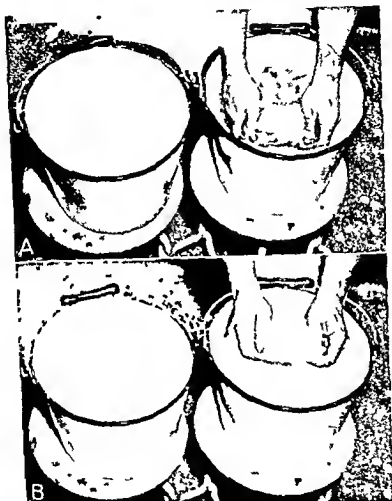


Fig 74 A Proper immersion of commercial plaster bandage. Bandage is grasped lightly at both ends and placed under water remaining there until bubbling has ceased. Second bucket in place and ready when water in first bucket has become saturated with plaster. B Proper wringing of the plaster bandage. Bandage removed from water and ends pressed gently but firmly together. No twisting or torsional squeezing.

course he was ill advised! The rubbing of the layers together makes the cast into one solid mass. If the cast is not rubbed the layers will



dry independently and the resultant cast will be in "onion skin" like layers without tensile strength. The rubbing is continued until the plaster has set—then further rubbing may be done to finish or polish



Fig 75—A Stockinette sheet wadding and protective felt padding in place B, Proper application of the plaster against the part casted—the bandage is kept against the part and is pushed around the part—no pulling or reversing

the cast and give a smooth outer surface. Too many casts are judged by this outer appearance alone. It is worth noting however that a poor cast may be finished smoothly while a good fitting cast may not be polished on the outside. The proof of a good fitting cast is the

absence of pressure points constricting bands and the like—and this can be proved at the time of removal of the cast by feeling for any irregularities on the inner surface

Where reinforcements are required additional plaster slabs may be applied. These may be made either on the flat surface of a table by



Fig 76—Making a plaster reinforcement "in the air." Note boots covering the shoes, operating pants and gown protecting the doctor.

rolling the plaster bandage back and forth to the exact length required or "in the air" as shown in Figure 76. Or the commercial

After the basic layers of plaster and splints are completed metal strips of either aluminum or strap iron may be incorporated before the final plaster is applied. These strips are shaped, either manually or by means of bending irons to conform exactly to the curves of the part cast. When the final layers of plaster have been applied, the cast is finished off by turning back the stockinette over the ends of the cast and incorporating the turned back ends of the stockinette into



the last layer of plaster. This gives a finish to the cast which is much

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## REPRESENTATIVE TYPES OF CASTS

**The Arm Cast.**—Figure 77, *B*, shows a finished cast of the arm, which extends only to the distal palmar crease, thus allowing full finger motion. This feature is important in casting an arm or forearm. Many times the casts have extended onto the fingers, thus limiting their motion, and as a consequence the fibrous adhesions about the finger joints have created more of a problem in restoration of function than was the original disability. With a disability of the arm or forearm, finger and thumb motions should be encouraged and insisted upon from the very beginning, therefore the plaster must not encroach upon their joints to limit motion in any manner.

**The Leg Cast.**—Figure 78, *A*, shows a completed cast of the leg in which the plaster on the plantar surface extends beyond the tips of the toes. There has been some argument as to whether or not this is correct. Some believe that the cast should stop just proximal to the metatarsophalangeal joint to allow plantar flexion of the toes in the same manner as the arm cast previously described allows full motion

the toes as in walking and in a step take off. There is relatively little normal plantar flexion. Thus the cast may be extended to or beyond the tips of the toes, with a cut out on the dorsal surface to allow for dorsal extension. Such a cast acts as a protection to the toes from bedclothes while the patient is in bed and as a "bumper" when the patient becomes ambulatory. Some have even advocated the incorporation into a foot cast of a spring wire projecting further out beyond the toes as an additional "bumper."

For casts of the lower extremities various accessories have been added to allow the patient to walk on the cast. The most common of these is the so called "walking iron." This is a U shaped piece of metal, usually about 1 inch across, applied to the cast with the apex of the U extending slightly beyond the sole of the foot. With one of these in place the patient pivots on the iron, whether it be bare iron or covered with rubber. With this pivoting motion the patient walks with a stomping gait and invariably rotates the leg outward. This gives rise to a very poor walking habit. Many adaptations have been

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ment, however, is a built up walking heel made of plaster and applied to the plantar surface of the foot by means of an extra roll of plaster bandage. This is shown in Figure 78, *B*. Just before this plaster heel sets the patient rests the foot on the floor and thus levels off the plaster heel at a proper walking angle. This is shown in Figure 78, *C*. It should be remembered that such a walking heel is not to be walked



Fig 78—A, Completed leg cast, showing plaster on plantar surface extending beyond toes as a "bumper" B, Plaster heel added to short leg cast. C, Plaster heel leveled off while plaster is still wet, giving a level walking surface

upon until the plaster is thoroughly hard or dry which is a minimum of seventy two to ninety six hours. During this period the patient walks with the aid of crutches but when the cast is dry it will take full weight bearing.

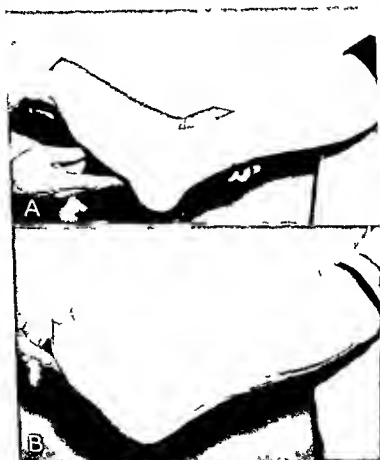
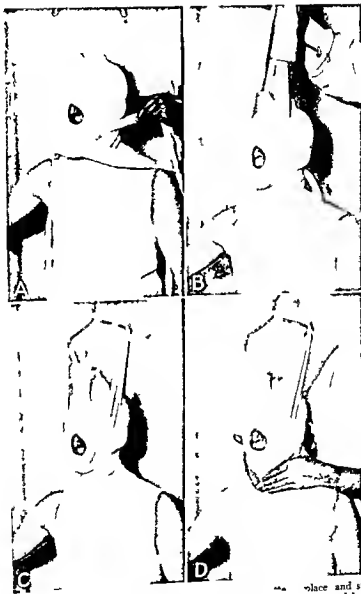


Fig 79—A A lightly padded leg cast—stockinette and two pieces of felt one around top of cast to protect the peroneal nerve the other for protection of the gastrocnemius tendon and the heel B Further progress with the lightly padded cast. Circular turns of plaster and a posterior reinforcement

Figure 79 A shows the beginning of a "slightly padded" leg cast. The stockinette is in place properly tailored with a piece of felt around the top as extra protection for the head of the fibula and the peroneal nerve and another piece of felt for protection of the gas



place and start  
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leted by tying  
the mand bles

muslin "tails" to overhead cross bow tie  
and under ears

trcnemus tendon and the heel Figure 79 B, shows a further step in the making of this cast One or two turns of circular bandage have been applied and a posterior plaster splint has been incorporated The cast would be finished off as shown in Figure 78

**The Neck and Body Cast**—Figure 80 A, shows the beginning of the application of a neck and body cast The stockinette is properly tailored and fitted with a cut out over the nose so the patient can breathe during the application Two sizes of stockinette are usually necessary—the larger for the trunk and the smaller for the head and neck When this type of cast is used it is usually necessary to have some type of head traction The simplest form is a six inch muslin



Fig 81—A Completed cast seen from the front B Completed cast from rear

bandage as shown This is torn leaving four "tails" with a center section about 4 inches long Figure 80 B shows the center section applied to the chin and the upper two "tails" brought around the mandible and crossed at the back of the head Figure 80 C shows the other two "tails" brought from under the chin directly upward The "tails" are then secured as shown in Figure 80 D

A muslin bandage and felt are used as described previously With the application of the plaster the cast is well molded particularly under the mandible as demonstrated in Figure 80 D The cast is trimmed the stockinette turned back and the cast finished as shown in Figure 81

Sheet width and felt are used as described previously With the application of the plaster the cast is well molded particularly under the mandible as demonstrated in Figure 80 D The cast is trimmed the stockinette turned back and the cast finished as shown in Figure 81



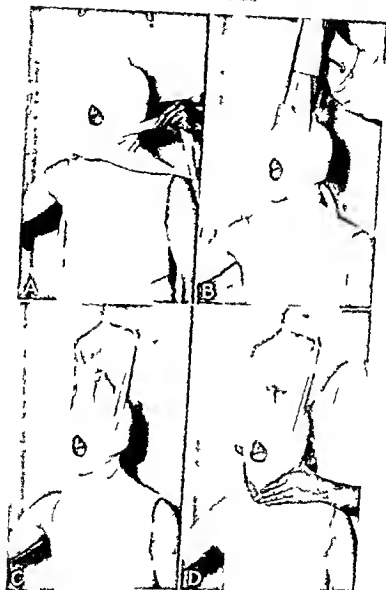


Fig. 80—A, Beginning of neck and body cast Stockinette in place and start of muslin traction tapes B Next step showing muslin tapes carried around head and second "tail" brought up from under chin C Traction completed by tying muslin "tails" to overhead cross bar D Molding of plaster under the mandible and under ears

### \* SCORING THE CAST AND ADDING CASE DATA

After application the cast particularly if it is an arm or leg cast should be partially to completely split so that there will be no embarrassment of circulation. While the plaster is still relatively soft it can be cut or scored with a knife as shown in Figure 82 A and B. Usually this cut is incomplete but serves as a guide if it becomes necessary to split the cast and is an aid in its eventual removal. It will be noted that with the application of anterior and posterior splints the "scoring" is done where the cast is thinnest so that the thicker portions of the cast may be retained as anterior and posterior shells.

Figure 82 C shows a finished arm cast that has been scored. A rough drawing may be seen on the surface of the plaster showing the location of the fracture and the general position of the bone fragments. This is an excellent idea particularly if the patient is to be transferred from one locality to another. It gives the receiving doctor a quick and serviceable picture of the injury. It is valuable also in check up x rays aiding the technician in properly centering his films. At the upper end of the cast are noted the date of the fracture, the type of fracture and the date of application of the cast. These are valuable data to have present. Also it is advisable to add the name or initials of the surgeon who applied the cast—any surgeon who has applied a well fitting cast should be proud to initial his handwork.

### MANAGEMENT OF THE PATIENT IN A CAST

Once the cast is applied it becomes the patient's problem to wear it. He must be made comfortable and instructed in its wearing and preservation. For comfort the cast must not be so heavy as to prevent the patient moving somewhat and in the case of a body cast it must permit the patient to be turned in bed. This turning is essential in the prevention of pressure points. We make it a rule that all patients in body casts must be turned on the side or abdomen at least eight hours out of each twenty four. Some patients have lacquered or varnished the casts so that the outside can be washed should it become soiled. This is an advantage with body and neck casts and with hip spica casts in children. The patient should be instructed that plaster casts must not become wet so that bathing is a problem and in most cases sponge baths must be resorted to.

If a patient should complain of a burning or pressure point under a cast it should be investigated at once. Prevention of pressure "sores" is much better than trying to cure them. When a patient complains, investigate! Windows can be cut in the cast, the windows saved and if no pressure points can be proved the window is reapplied and plastered shut again. Never should the window be left out. If this is done the tissues will become edematous under the window and the

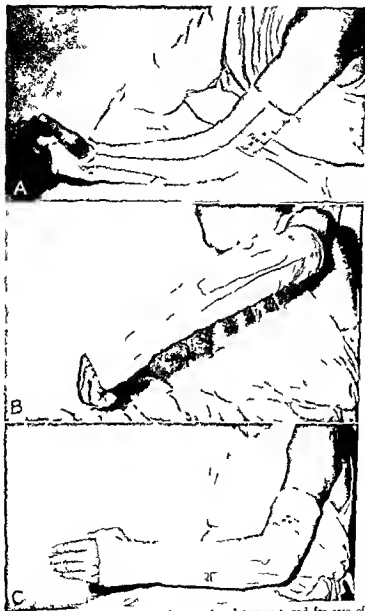


Fig 82—A "Scoring" of arm cast for ease in splitting cast and for ease of removal B "Scoring" of cast on opposite side from A C Finished arm cast "scored" on both sides and then rough drawing of the fracture line as well as date of fracture and date of application of cast

bivalving is still the better method because with it there will be no torsion in removal such as is commonly the case when the cast is split on one side and then pried off

#### COMMENT AND SUMMARY

To get the real feel of a cast the physician should have one applied to his own arm and leave it on for three or four days. He can then be the judge of the technic of application how well it fits how comfortable or uncomfortable it is so that when patients complain to him about their casts he knows whereof they speak

The final point to be remembered in plaster of Paris technic is that the patient who has been immobilized in plaster must be guided in the restoration of function of the muscles and joints. This is perhaps the most important point of all. What avails it if a fracture has been reduced properly casted the cast removed and then the patient has no function of the extremity? All the work has been in vain. Restoration of function requires active exercises some heat and massage (physio psycho therapy) and support to the part if necessary. Swelling should be prevented insofar as possible by elevation of the part between periods of activity support by means of woven bandages occasionally an Unna paste boot or similar aid

cast must be properly and painlessly removed and then when all of this has been done the restoration of function must be accomplished.

patient will be worse off than before. Also, in splitting a cast to relieve pressure or circulation, the cast should be split adequately. This, in the case of a leg cast, is from the toes to the knee and in an arm cast from the fingers to the elbow. Anything less than this is not sufficient.

### REMOVAL OF THE CAST

Many patients fear the removal of the cast more than its application. It is true that many casts have been removed in a rough manner, and patients have been hurt. This should not be. Figure 83

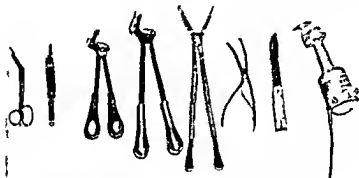


Fig. 83—Instruments used in removal of a cast. First is a pair of bandage scissors.

shows the necessary "tools" for removal of a cast. These are explained in the legend accompanying the figure.

In removing a cast it is always better to bivalve it and remove it in two pieces. If removal is done regularly in this manner when one wishes to save one half of a cast for gradual release from the immobilization the splint is ready. If one is going to dispose of the cast,

cent polymorphonuclear neutrophils, 5 per cent lymphocytes and 4 per cent monocytes. Blood chemistry showed nonprotein nitrogen 57 mg per 100 cc., creatinine 14 mg per 100 cc., total protein 5.1 gm per 100 cc and icteric index 26. The electrocardiogram revealed a tachycardia, tendency towards left axis deviation and occasional auricular and ventricular extrasystoles. X ray of the chest revealed enlargement of the heart to the left with increased lung markings bilaterally, which was interpreted as being compatible with organic heart disease and decompensation. The Kahn test was negative.

The patient was digitalized, given ammonium chloride and placed on supportive therapy. Abdominal paracentesis was performed and 3 quarts of a yellowish, turbid fluid was secured; this was nonfecal in character and upon microscopic examination revealed the presence of many neutrophils and mesothelial cells. Its protein content was 3.8 mg per 100 cc. No culture was reported. Forty-eight hours after the abdominal tap the patient developed a low grade fever, severe diarrhea and fecal incontinence. The stool gave a 2 plus positive benzidine test (no meat-free diet). The patient was placed on intravenous saline dextrose and sulfadiazine therapy but did not respond. Her abdomen became distended with fluid again. A diagnostic tap was performed and 10 cc of fecal smelling, yellowish gray material was aspirated which on culture showed *Bacillus coli*. Penicillin, 100 000 units, was instilled in the peritoneal cavity. The patient continued to grow rapidly worse and died that same day, September 6, two weeks after being admitted to the hospital.

**Summary of the Clinical History**—The physical examination and the laboratory evidence indicate heart disease with recurrent episodes of congestive failure which responded to therapy while hypertensive heart disease was primarily considered because of the absence of a history of rheumatic fever. The findings on physical examination suggested rheumatic etiology. Upon admission to the hospital congestive failure was present. In addition abdominal pain, fever, leukocytosis and icterus without evidence of obstructive jaundice presented a confusing clinical picture. The abdominal paracentesis indicated peritonitis by the character of the aspirated fluid. Now hepatitis can be inferred. This evidence of peritonitis, however, was uncovered just before the patient died.

could not be ventured because of the meager evidence accumulated as a result of the masking by the dominating cardiac symptoms and because of the critical condition of the patient. Dr. Popper will now tell us what he found at autopsy.

**DR. HANS POPPER:** The body was markedly emaciated. There was ankle edema and distention of the abdomen. At autopsy, 1000 cc of gas escaped and about 1000 cc of fluid was evacuated. The intestinal loops were matted together by a thick layer of fibrinous plastic exudate. Histologically, the peritoneal wall revealed a moderate inflammatory reaction with many leukocytes. The organization of the exudate was such that the adhesion of the organs was complete. The adhesion of the organs was complete as noted.

## ADDITIONAL ARTICLE

### CLINICOPATHOLOGIC CONFERENCES

Cook County Hospital, Chicago

ITALO F. VOLINI, M.D., F.A.C.P.\* AND HANS POPPER, M.D., PH.D.†

#### CASE I. DIVERTICULITIS OF THE COLON, OLD RHEUMATIC HEART DISEASE AND HEPATITIS

DR. ITALO F. VOLINI: This patient (P.M. 849-46) a white woman aged 49 gave a negative past history except for dyspnea on exertion for three years and varicose veins for five years.

About two years prior to the patient's hospital admission she began to complain of nausea, dyspepsia and intolerance to fatty foods. About a year ago she developed swelling of the legs and abdomen which lasted for one month and then

stools. In the year prior to her hospital admission she had lost 100 pounds.

Physical examination revealed an emaciated patient who did not appear acutely ill. Her temperature was 99.4° F., pulse 120, respirations 24 and blood pressure 140/90. The head and neck were essentially negative except for an icteric tinge of the sclerae. There were fine crepitant rales in the bases of both lungs with some bronchial breathing in the right lower and left upper lobes. The heart was en-

present there were 20,400 white blood cells with a differential count of 91 per

was marked distention of the sinusoids. In the center of the lobules the liver cells revealed marked degenerative changes. They had in addition a foamy appearance, and were crowded with glycogen, which was demonstrated by the periodic acid-Schiff reaction.

However, the marked central congestion simulating the picture seen in heart failure can also be explained by shock. The large spleen weighing 400 gm shows a chronic irritation with dilatation of the sinusoids and marked cellular proliferation of the endothelial cells.

The heart was somewhat enlarged, the apex being formed by the left ventricle. The mitral ostium was narrowed, the leaflets thickened, the chordae tendinae were fused. Also, the aortic valve revealed fibroplastic deformity typical of an old rheumatic process.

There was one other finding in this case which is of particular interest to the surgeon, namely, a peptic esophagitis. We have seen quite often recently this superficial or deeper digestion of the esophageal mucosa. It is produced by regurgitation of stomach content. It is also believed that intubation procedures like that of Wangensteen may cause such a lesion which in our case was rather extensive and extended through the mucosa (Fig 85 B).

In correlating the anatomical and clinical findings we have a woman who complained for three years of cardiac distress with episodes of decompensation apparently due to right heart failure, edema and ascites. They appeared repeatedly and disappeared as a result of cardiac treatment. We would like to correlate these symptoms with the chronic rheumatic heart changes. For several years she had some vague gastrointestinal symptoms which were not given much consideration. We now associate them with the gradually developing diverticulitis.

Diverticula are not uncommon. They develop mostly in the sigmoid primarily in elderly people and especially in women. They are usually considered as a result of an increased pressure due to constipation. Mucosa and submucosa are pressed through weakened spots of the mucosal layer usually around vessels thus giving rise to the gradually enlarging saccular pseudodiverticula. Passive congestion or heart failure may be a contributing factor. Most of the patients have no symptoms but sometimes there may be chronic inflammation in and around diverticula and the developing fibrosing perisigmoiditis causes symptoms clinically very much like carcinoma. Rarely however, they may become malignant. The patient in this case had no symptoms early (before the development of the heart disease) but later on she developed progressive swelling of the abdomen and progressive weight loss.

The patient was unable to respond to medical treatment and progressive swelling of the abdomen developed. We assume that at this time the patient developed a chronic peritoneal



which communicated with the free abdominal cavity and through a small hole with the lumen of the sigmoid. On closer inspection of the latter, a large number of diverticula were found, about 4 to 5 mm in length. They were really pseudodiverticula because only mucosa and submucosa and not the entire wall participated in their formation. As is usually the case, formed fecal material and fecaliths were impacted in them as could be seen on inspection from the mucosa (Fig. 84). One of these diverticula perforated, not too recently, causing a subacute peritonitis, which apparently was several weeks old



Fig. 84



Fig. 85

Fig. 84—Pseudodiverticula of the sigmoid. The entrances are marked by paper arrows. The perforated diverticulum is probed.

Fig. 85—A, Extensive central necrosis of the liver. The liver cell cords in the involved area have disappeared and only a few anuclear cell fragments are seen between the collapsed connective tissue framework. B, Peptic esophagitis. The mucosa and greater parts of the submucosa are partially digested. The superficial layers of the former are missing.

As a result, we found evidence of chronic autointoxication. For instance, the cell cords of the adrenal cortex were separated by edema and in their centers lumina were filled with endogenous toxins. The adrenal picture has been described by Koch as typical for severe poisoning. The adrenal was very large—2,000 gm in weight. The anterior edge was blunt and on the cut surface the lobular markings were exaggerated. Histologically, there

There may be single lesions of diverticulitis elsewhere, for instance, in the cecum with acute rupture or in the small bowel or in the esophagus. We have operated upon a perforation of an enormous diverticulum of the jejunum and of the duodenum.

**DR VOLINI:** Dr Leonard Cardon, the attending physician, will discuss this case.

**DR LEONARD CARDON:** This patient did not present the clinical picture of peritonitis until shortly before her death. The progressive ascites and edema of the sacrum and legs were ascribed to failure of the obviously organically diseased heart. Peritoneal carcinomatosis secondary to a primary lesion in the stomach or ovary was also considered. The patient was never strong enough for gastrointestinal x-ray study. It was not until the last forty-eight hours of her life that signs of peritonitis appeared. There are two possibilities.

The most likely is that a sterile cardiac ascites was secondarily infected by the superimposed sigmoid diverticulitis. Or recurrent minute perforations with slow and minimal leakage could produce low grade inflammatory peritonitis with recurrent episodes of ascites which resolved spontaneously as the perforations healed and local peritoneal immunity developed. It seems reasonable to speculate that in patients with previously asymptomatic and silent colonic diverticulosis who develop cardiac failure, chronic passive congestion and edema of the tissues about the orifices of the diverticula, constricting and obstructing them and interfering with their drainage, and the prolonged bed rest, constipation and even fecal impaction common in these patients producing fecal stasis, retention and inspissation in the diverticula combine to favor the development of diverticulitis and perforation.

**DR VOLINI:** The peritonitis was diagnosed in addition to the heart disease and hepatitis. The cause of the peritonitis could not be adduced from the evidence presented nor was it possible to secure further necessary evidence. Because of the seriousness of the combined lesions, it is extremely doubtful whether any therapy could have changed the course of events in this patient.

## CASE II: SACCULAR ANEURYSM OF THE LEFT BRANCH OF THE HEPATIC ARTERY

**DR ITALO F. VOLINI:** This 61-year-old white (P.M. 1108-46) housewife was admitted to Cook County Hospital on September 23, 1946, with a three-day history of severe epigastric pain, jaundice and tarry stools.

The patient's past history revealed that in January, 1946, she began to complain of bouts of right upper abdominal pain. Investigations at Cook County Hospital and at another hospital for gallbladder and genitourinary disease proved nega-

irritation due to the still well covered leak and the walled-off abscess. Sharp pains, nausea and vomiting appear but the bowel movements are still normal. She loses weight, becomes anorexic but is still not acutely ill and the process is masked by the ascites. However, dehydration develops, indicated by the high red blood cell count, and hypoproteinemia is found due to impaired intestinal absorption. The high white blood cell count results from the peritoneal irritation. Finally she becomes icteric, serum protein nitrogen rises and the liver fails apparently as a result of endogenous toxins as well as shock, this liver damage being the ultimate cause of death.

DR VOLINI: Dr. Karl Meyer will discuss the clinical and surgical aspects of this disease.

School cited instances of diverticulosis in which the patients had been kept comfortable on medical management for over thirty years.

Diverticula may show perforation, spasm or obstruction. Slow perforation may occur accompanied by lower abdominal distress, constipation and sometimes diarrhea. There may be tenesmus, fever and leukocytosis in recurring bouts. The question comes up—what to do? Tapping of a nonlocalized abscess is dangerous so we put the patients

the presence of nausea and vomiting. Wangenstein suggested a 10 cc bag to the site may be recommended. After drainage operations

prefer to do a proximal transverse colostomy. However, we believe the mortality with the latter procedure is higher. We allow the patient to go along for three to five months with colostomy functioning. If the obstruction does not improve apparently as a result of too much fibrosis, a resection is on rare occasion indicated as in a carcinoma.

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about 100 cc  
- - - - -

Operation was decided upon, and after preparation with repeated blood transfusions and other supportive measures, she was operated upon. An empyema fluid

drain from the cholecystostomy tube, and on the seventh postoperative day the

November 10, 1940, forty-seven days after her last admission to Cook County Hospital

This is a long and dramatic history characterized by episodes of upper abdominal pain, intermittent obstructive jaundice and symptoms of shock associated with massive hemorrhages. The exsanguinating hemorrhages

radicles seemed involved for which cholecystostomy was performed under hazardous surgical circumstances. Extensive investigation for the presence of any type of contributing hemorrhagic disease failed to disclose any evidence. The operative procedure did not add much knowledge to the cause of the hemorrhages which persisted and produced death.

Dr Popper will now reveal his findings.

DR HANS POPPER. At autopsy, very little jaundice was seen. The interest in a patient with such a history concentrates upon the liver. It was larger than usual, brown red in color, not icteric. The first incision revealed in the depth of the liver, left of the middle line, a large cavity of almost hen's egg size which was filled with a lamellated red and brown blood clot. The cavity had a thin fibrous wall to which the clots firmly adhered. The rest of the liver showed, except for some brown discoloration around the cavity, a normal lobular pattern. Further dissection revealed that the left main branch of the hepatic duct was markedly dilated and contained some recent blood clot. It com-

tive. The only findings were a slightly enlarged heart and a blood pressure of 190/90. With symptomatic therapy she improved, and after a three weeks hospital stay she was discharged on February 24, 1946.

Onset of her illness eight months ago, the patient's past medical, surgical and family histories were essentially negative.

Physical examination upon admission revealed a well-nourished, well-developed elderly white woman who was anemic and questionably jaundiced but did not appear acutely ill. Her temperature was 99.2° F, pulse 84, respirations 24 and blood pressure 140/80. Examination of the head and neck was essentially nega-

The remainder of the physical findings, including the neurologic and pelvic, was negative.

gram) and atropine 0.5 mg ( $\frac{1}{2}$  a grain) relieved her symptoms, but the next morning it was found that she had become markedly jaundiced. Parenteral vitamin K was then added to her therapy. The following day the patient had another attack of severe epigastric pain. This time she appeared to be in shock with a cold

hepatic artery was traced into this cavity (Fig 3, B) It, then, represents a saccular aneurysm of the left branch of the hepatic artery.

... of the ... did not reveal much  
dense connective tissues  
ble a wall of an artery

There was some cellular infiltration but not much inflammatory change (Fig 87) The liver structure around the aneurysm was destroyed by hemorrhage, blood apparently had dug its way into the parenchyma In the vicinity, there was extensive necrosis of the parenchyma Furthermore, infiltration of the periportal fields associated with proliferation of the bile duct, both apparently due to irritation from liver cell breakdown products, was present Further away from the aneurysm, the liver cell cords revealed some disassociation and

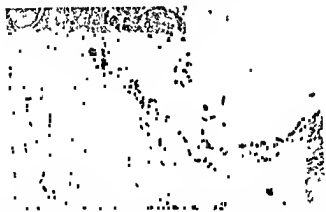


Fig 87—Histologic picture of the diverticulum of the hepatic artery The wall is formed by a dense connective tissue with little inflammatory infiltration The inner surface is covered by blood clots in organization

necrobiosis These central lobular toxic changes are best explained by the anemia

The intrahepatic bile ducts were not dilated However, the main hepatic duct was slightly so, as was the common duct, and, in both, liquid blood clots were found They were also seen in the cystic duct, in the papilla of Vater, in the stomach and intestine The patient obviously bled to death from a hemorrhage due to a rupture of an aneurysm of the hepatic artery into a branch of the hepatic duct

Around the gallbladder, which showed a recent cholecystostomy, there were fibrous adhesions Its wall was thickened and revealed gross and microscopical evidence of chronic inflammation

The spleen was enlarged, hyperemic and hyperplastic due to so-called posthemorrhagic softening The brain showed degenerative changes apparently caused by chronic anemia



Fig. 86—A, Cut surface of liver revealing the large diverticulum filled with blood clots. The communication with a dilated branch of the left hepatic duct is probed. B, View of the diverticulum from the inferior surface. The communication with the left branch of the hepatic artery is indicated as well as the opening of the cystic duct into the slightly dilated common duct.

communicated through a small opening with the described cavity (Fig. 86, A). This cavity reached almost to the inferior surface of the liver but was still covered by the liver capsule. The left branch of the

was done but the aneurysm within the liver could not be seen. As a result of several more attacks characterized by the mentioned triad the patient bled to death.

**DR. VOLINI:** Dr. Manuel Lichtenstein will now discuss the surgical aspects of the presentation.

**DR. MANUEL LICHTENSTEIN:** This is a rare condition and is surgically significant because of diagnosis and therapy. Even at operation the diagnosis may be missed. If you can picture in the right upper quadrant just beneath the liver a large blood clot in the vicinity of the bile duct and the vessels you can understand the hesitation of even the boldest surgeon to probe the mass. Once you make a hole in this mass and blood comes out it comes out faster than you can stop it or pour it back into the patient. Most of these cases have been diagnosed at postmortem examination.

A number of symptoms and signs are found in common in all of these patients. Most of them have pain; half of them have hemorrhage in the form of hematemesis or melena. Among the eighty-five cases reported, paroxysmal pain in the right upper quadrant or epigastrium was found in fifty-eight; hemorrhage in forty; jaundice of an obstructive nature in thirty-six; and sixty-seven of the eighty-five had a rupture of the aneurysm into the abdominal cavity, extrahepatic ducts, duodenum, gallbladder, portal vein or stomach. The first symptom may be shock due to rupture of the aneurysm with exsanguination. Even in the thirty cases with operation the diagnosis was usually not made because the rarity of the condition makes it difficult to keep it in mind since pain, jaundice and hemorrhage are common symptoms in many other conditions.

At operation the treatment would be proximal ligation with excision of the aneurysm. This is possible if the aneurysm is small, has arisen from the cystic artery and has not perforated. With removal of the gallbladder the patient can be cured. The ligation of an interhepatic aneurysm is not always successful because the liver cannot survive loss of its blood supply. Six of ten patients in whom the hepatic artery has been ligated accidentally died from hepatic necrosis and the remainder did not get well. Therefore ligation of a large vessel does not guarantee cure. Other vessels than the celiac axis may sometimes supply the liver; for instance, the superior mesenteric artery. In such an instance ligation of the main vessel may not be followed by necrosis. In only one case on record the aneurysm was dissected out, the main vessel ligated, and the patient survived, but we do not have details of the accessory blood supply in this case.

In conclusion, this is a rare condition, difficult to diagnose even at operation except on suspicion, and beneficial treatment is rarely possible.



As to incidental findings, there was a mild arteriosclerosis in keeping with the preceding history of hypertension.

The question as to the etiology of the aneurysm arises. Many factors have been mentioned in similar cases, but do not apply in this one. We have no history of trauma, we do not find arteriosclerosis nor was there evidence of syphilis or cholelithiasis. Infection is the most common cause of such a condition. In our case, possibly the gall bladder was the source. The patient, several months ago, had pain in the right upper quadrant associated with leukocytosis and that may indicate a cholecystitis although the Graham-Cole test at that time was normal. Nevertheless, we are of the opinion that the cholecystitis was the cause of the aneurysm.

The clinical symptoms were characteristic as judged from cases previously reported. There was colicky pain. How can we explain this pain? It could be caused either by biliary obstruction or more probably the hemorrhage within the liver stretched the rather sensitive Glisson's capsule. The second symptom is jaundice. The results of the liver function tests indicate that this was an obstructive type of jaundice.

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tion, thymol turbidity, cholesterol ester ratio and prothrombin time were normal and only occasionally was the albumin-globulin ratio lowered. The elevation of the nonprotein nitrogen was produced by the intestinal hemorrhage. The transient obstructive jaundice was apparently caused by blood clots within the ducts. When the clots passed, the jaundice subsided. The third symptom usually listed is

which was in our case due to the perforation. The fourth cardinal symptom was absent in our patient since

In an attempt to correlate clinical and autopsy findings, we note that abdominal pain first occurred ten months before death. Possibly this accompanied the first perforation though it may just as well have been due to a cholecystitis. The attending physician thought of a urologic disease but no characteristic findings were elicited. The patient was then comfortable for eight months. Two months before death, she developed repeatedly the typical triad of jaundice, pain, intestinal hemorrhage, apparently due to recurrent hemorrhages from the aneurysm into the duct. In the periods between them, the communication was apparently sealed off by blood clots. After the fourth attack, when again many tarry stools were passed and shock developed, a laparotomy was performed. Blood was found in the gall bladder which had entered through the cystic duct. A cholecystostomy

# INDEX

- abscess collar button 35
  - palmar space middle 35
  - perinephric 206
  - peritonsillar 89
  - periurethral 212
  - retropharyngeal 90
  - subungual 31
  - thenar space 36
- Acid burns of eye 54
- Actinomycosis of neck 62
- Adenitis cervical acute 60
- Adenoid remnants 89
- Adenoma of breast 96
- Alkali burns of eye 54
- Amputation of cervix uteri 225
- Anesthesia circulatory hazards 235
- for minor surgery hazards 228 240
- local hazards 237
- Aneurysm 162
- arteriosclerotic 162
- mycotic 163
- saccular of left branch of hepatic artery clinicopathologic conference 267
- traumatic 164
- Angina Ludwigs 62
- Arm plaster cast for 253
- Arterial embolism 134
- insufficiency acute 154
- occlusion gradual 170
- thrombosis 160
- trunks trauma to interrupt on 158
- Arteriosclerosis 170
- Arteriosclerotic aneurysm 162
- Arteriovenous fistula 166
- congenital 166
- traumatic 166
- 
- BALANITIS 915
- Bartholin's gland lesions 227
- Bopsy endometrial 224
- of cervix in diagnosis of carcinoma 222
- of testis 219
- of tumors of head and neck area 81
- of pharynx 95
- Bites human hand infections from 40
- Bladder catheterization 207
- foreign bodies in 181
- injuries 209
- suprapubic puncture 209
- Blepharitis 48
- Blood pressure cuff in wounds of hand 9
- Body plaster cast for 257
- 
- Branchial cleft cysts 64
- Breast carcinoma chronic cystic mastitis and 109
- tumors benign 95-112
- treatment 101
- Bronchus foreign bodies in 179
- Buerger's disease See *Thromboangitis obliterans*
- Bumons 198
- Burns methods of removing slough 128
- of eye 54
- of eyelids 52
- whole thickness local treatment 125 133
- Bursa nasopharyngeal 92
- 
- CALCULUS salivary 66
- urethral 213
- Calluses 202
- 
- of cervix uteri biopsy in 222
- of eyelid 49
- of lip 78
- of neck metastatic 66
- of skin 78
- Cardiac arrest in anesthesia 235
- Casts plaster technic of application 241 261
- Catheter passing in urethral or bladder injures 210
- 
- cauterization 225
- coagulation 225
- dilatation 224
- Chalazion 43
- Chronic acid bead in epistaxis 83
- Cilia in lacrimal puncta 49
- Circulatory hazards in anesthesia 235
- Circumcision 214
- Clinicopathologic conferences Cook County Hospital 262-274
- Colds common 87

DR ITALO F VOLINI One must add to the list of possible causes of obstructive jaundice, then, bleeding aneurysm of the hepatic artery. In addition, hematemesis and melena must be also listed. The oxygen supply to the liver in the absence of collateral arterial circulation is almost wholly dependent upon the hepatic artery, and ligature of this vessel for the cure of hepatic artery aneurysm is frequently disastrous where a diagnosis has been made.

- Injection treatment of sprains 189  
   of varicose veins 145  
     complications 150  
 Injuries of bladder 209  
   of eye, 51  
   of neck 56  
   of testis 216  
   of urethra 212  
 KELLER procedure in bunions 200  
 Keratoses seborrheic 76  
   senile or precancerous 76  
 LACERATIONS of conjunctiva 52  
   of eyelids 51  
   of neck 56  
 Lacrimal puncta cilia in 49  
   stricture 50  
 Laryngospasm in anesthesia 232  
 Larynx foreign bodies in 179  
 Leg plaster cast for 253  
 Leukemia neck lesions in 67  
 Leukoplakia of lip 77  
 Lewyite eye injuries from 54  
 Ligation of vas deferens 290  
 Lip carcinoma 78  
   leukoplakia of 77  
 Lipoma of head and neck 63 71  
 Ludwig's angina 62  
 Lymphadenitis cervical, chronic 61  
   tuberculous 61  
 Lymphosarcoma of neck 87  
 MASTITIS cystic chronic 109  
   treatment 108  
 Melanoma subungual 198  
 Milium 49  
 Minor surgery responsibilities of 1-3  
   symposium on 1  
 Mixed tumors of neck 65  
 Moles of head and neck area 63 74  
   removal of 75  
 Molluscum contagiosum 49  
 Mustard gas eye injuries from 54  
 Mycotic aneurysm 163  
 Myxoma of breast 99  
 NASAL hemorrhage 82  
   septum hematoma of 86  
 Nasopharyngeal bursa 92  
 Nasopharyngoscopes 90 91  
 Neck infections 59  
   injuries 56  
   in minor surgery 56-68  
   plaster cast for 257  
   tumors 63 69  
 Nevus flammeus 72  
   pigmented of head and neck area 74  
   of neck 63  
   strawberry 72  
 Nose foreign bodies 87  
   fractures 86  
   in minor surgery 82-88  
 Nosebleed 82  
 ORCHITIS 217  
 PACK nasal anterior 84 85  
   posterior 84 85  
 Palmar space middle abscess of 35  
 Papilloma of breast 96  
   of eyelid 49  
 Paraphimosis 216  
 Paronychia 31  
 Parotid gland mixed tumor 65  
   Pate's test 117  
 Plaster casts technique of application 241  
   261  
 Plantar wart 203  
 Polyps nasal 88  
 Port wine stain 72  
 Psychoneurotic testicular complaints in 221  
 Pterygium 47  
 RADIIUM therapy in gynecology 226  
 Refrigeration in wounds of arteries 161  
 Respiration artificial in anesthesia accidents 231  
 Respiratory hazards in anesthesia 230  
 Retropharyngeal abscess 90  
 Reverdin grafts 116  
 Rhinitis hyperplastic chronic 87  
 Rudnick Vaughan test 211  
 SALIVARY gland calculus 66  
   tumors 65  
 Saphenofemoral junction anatomy 136  
   ligation and distal injection for varicose veins 142 144 148  
 Saphenous vein anatomy 135  
 Scalp tumors benign 69  
 Scrotal support, 216  
 Sebaceous cysts 69  
 Serpentine ulcer of cornea, 55  
 Silver nitrate in epistaxis 84  
 Skin carcinoma 78  
   foreign bodies in 174  
   grafts 113-124  
   choice of 119  
   donor areas 119  
   free full thickness (Wolfe) 117  
   "gluing" techniques, 123  
   intermediate split thickness 116  
   isografts 119  
   methods of cutting 120

- Collar button abscess 35  
 Colon, diverticulitis with old rheumatic heart disease and hepatitis clinico-pathologic conference 263  
 Colpocentesis 225  
 Colpopentoneoscopy 225  
 Colpotomy 225  
 Compression dressing in open wounds of hand 11  
 Conization of cervix, 225  
 Conjunctiva diseases minor surgery of 46  
   hemorrhages 52  
   lacerations 52  
 Conjunctivitis acute purulent, 46  
   allergic 46  
   gonorrheal, 46  
 Contusions of neck 59  
 Cornea ulcer serpentine 55  
 Coras 202  
 Curettage cervical 222  
   endometrial, 222  
 Cystic hygroma 68  
 Cystosarcoma phyllodes of breast 98  
 Cystostomy suprapubic 209  
 Cysts cervical lateral, 64  
   sebaceous 69  
   thyroglossal duct, 61  
  
 Davis grafts, 116  
 Dilatation of cervix uteri, 224  
 Dislocation of toe 200  
 Diverticulitis of colon with old rheumatic heart disease and hepatitis clinico-pathologic conference 262  
  
 ECTROPION 49  
 Electrocautery in epistaxis 83  
 Embolotomy 155  
 Embolism arterial, 154  
 Emphysema of eyelids 52  
 Endometrial biopsy 224  
 Entropion spastic, 51  
 Epididymitis gonorrheal, 217  
   nonspecific, 218  
   tuberculous 218  
 Epistaxis 83  
 Epithelial horns 77  
 Eponychia 31  
 Esophagus foreign body in 179  
 Exostoses subungual, 198  
 Eye burns 54  
   foreign bodies in 53 179  
   minor surgery of 46-55  
   penetrating injuries 52  
 Eyelids infections 47  
   diseases minor surgery 47  
   trauma 51  
  
 FACE, tumors benign, 69  
 Felon, 32  
 Fibroadenoma of breast, 98  
  
 Fingernail, foreign body under 174  
 Fingers fractures of 191  
   subfascial infection, 33  
 Fistula, arteriovenous 168  
   thyroglossal duct, 63  
 Foot, minor surgery 196-205  
 Foreign bodies 174-184  
   as respiratory hazard in anesthesia 233  
   in eye 53 179  
   in nose 87  
   in urethra 213  
   management, 174  
   prevention 181  
 Foreskin redundant, 214  
 Fracture-dislocations, 193  
 Fracture-sprains 192  
 Fractures minor 190-195  
   of nose 86  
   of phalanges 191  
   of toe 200  
   subperiosteal 194  
 Furuncles nasal, 88  
   of neck, 59  
  
 GASTROINTESTINAL tract foreign bodies in 179  
 Gonorrheal conjunctivitis 46  
   epididymitis 217  
 Grafts skin 113-124  
 Grease injected accidental, 175  
 Gynecologic surgery minor 222-227  
  
 HALLUX valgus 198  
 Hammer toe 201  
 Hand, infections 27-45  
   acute spreading 29  
   human bite 40  
   major space 35  
   minor space 30  
   postoperative care 43  
   splint, universal, 23  
   wounds open, treatment, 4-26  
 Head tumors superficial 69-81  
 Heel painful 203  
 Hemangioma of head and neck, 72  
 Hematoma of nasal septum 86  
   subungual 197  
 Hemorrhage nasal, 82  
   subconjunctival, 52  
 Hepatic artery left branch, saccular aneurysm clinico-pathologic conference 267  
 Hodgkin's disease neck lesions 67  
 Hordeolum, 47  
 Horns epithelial, 77  
 Hydrocele of tunica vaginalis 218  
 Hygroma cystic, 68  
 Hymenectomy 227  
  
 INFECTIONS of hand 27-45  
   of neck, 59



- Skin grafts pedicle 117  
     postage stamp or flagstone 115  
     preparation of recipient areas 123  
     refrigeration of, 123  
     Reverdin (pinch or Davis) 118  
     Stent, 116  
     Thiersch 114  
 Spermatocoele 219  
 Splint hand universal 23  
     use following surgery of hand 11  
 Sprains 185-190  
     of neck, 59  
 Stent grafts 116  
 Straddle injuries of urethra 212  
 Strains of neck 59  
 Strawberry nevus 72  
 Stricture of urethra 211  
     of urethral meatus 211  
 Style 47  
 Subcutaneous tissues foreign bodies in 174  
 Subfascial infection digital, 33  
 Subperiosteal fractures 191  
 Subungual abscess 31  
     lesions of toenail, 197  
 Surgery minor symposium on 1  
 Syndactylism 201
- TAILOR'S bun on 209  
 Tampons postnasal and intranasal 84  
 Tear gas eye injuries from 54  
 Tendons repair in open wounds of hand 6  
 Tenosynovitis acute 37  
 Testis biopsy 219  
     complications in the psychoneurotic 221  
     inflammatory conditions 217  
     injuries 216  
     torsion, 217  
 Thenar space abscess 36  
 Thiersch grafts 114  
 Throat, minor surgery 89-94  
 Thromboangitis obliterans 172  
 Thrombosis arterial, 160  
 Thyroglossal duct cysts and fistulas 63  
 Thyroid tumors of neck 64  
 Toenail, dorsal hypertrophy 197  
     horn formation on 197  
     ingrown, 196  
     subungual lesions 197  
 Toes affections of 198 200 202
- Torsion of testis 217  
 Tourniquet test for varicose veins 139  
 Trachea foreign bodies in, 179  
 Trendelenburg test for varicose veins 140, 141  
 Trichloroacetic acid in epistaxis 84  
 Tuberculous epidermoids 218  
     lymphadenitis 61  
 Tumors of breast benign 93-112  
     of head and neck area superficial 69-81  
     of neck 63  
     of pharynx 93  
 Tunica vaginalis hydrocele 218  
 Turbates hyperplastic 88
- ULCER serpentine of cornea 53  
     varicose 134-153  
 Ultraviolet light, eye injuries from 53  
 Urethra foreign bodies in 213  
     injuries 212  
     stones 213  
     stricture 211  
 Urethral meatus stricture 211  
 Urine retention acute 207  
 Urologic surgery minor 206
- VARICOCELE 220  
 Varicose ulcers 134-153  
     treatment 147  
     veins combined saphenofemoral ligation and distal injection 142 144 148  
     complications 147  
     diagnostic tests 139  
     injection treatment, 143 150  
 Vas deferens ligation, 220  
 Verruca vulgaris 71
- WARREN incision on of breast, 101  
 Warts 71  
     plantar 203  
 Web space infection, 34  
 Wen 69  
 Wolfe grafts 117  
 Wounds of arterial trunks 158  
     of hand open treatment 4-26
- XANTHOMA 49

